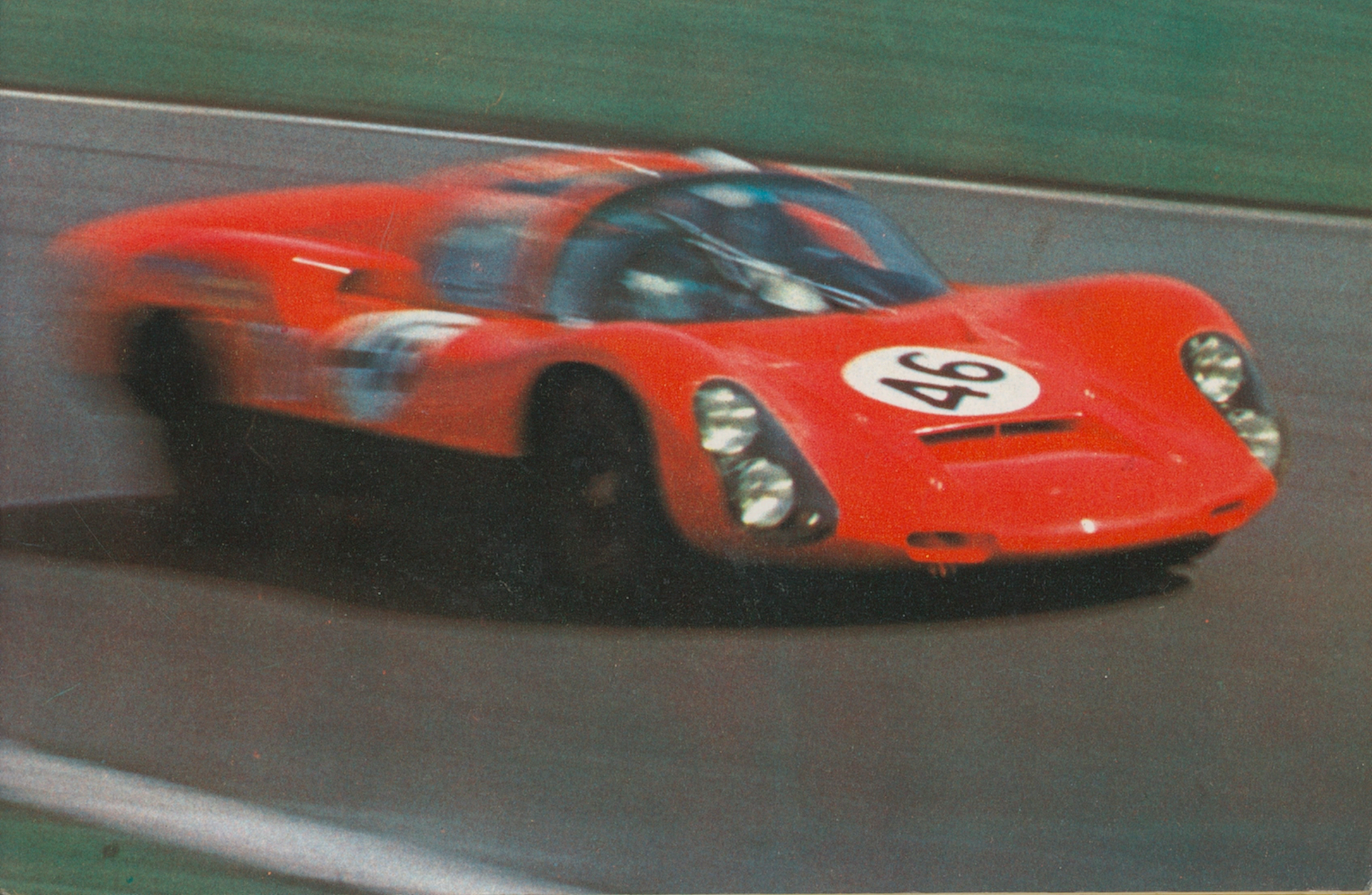
# THE SuperBook OF Cars



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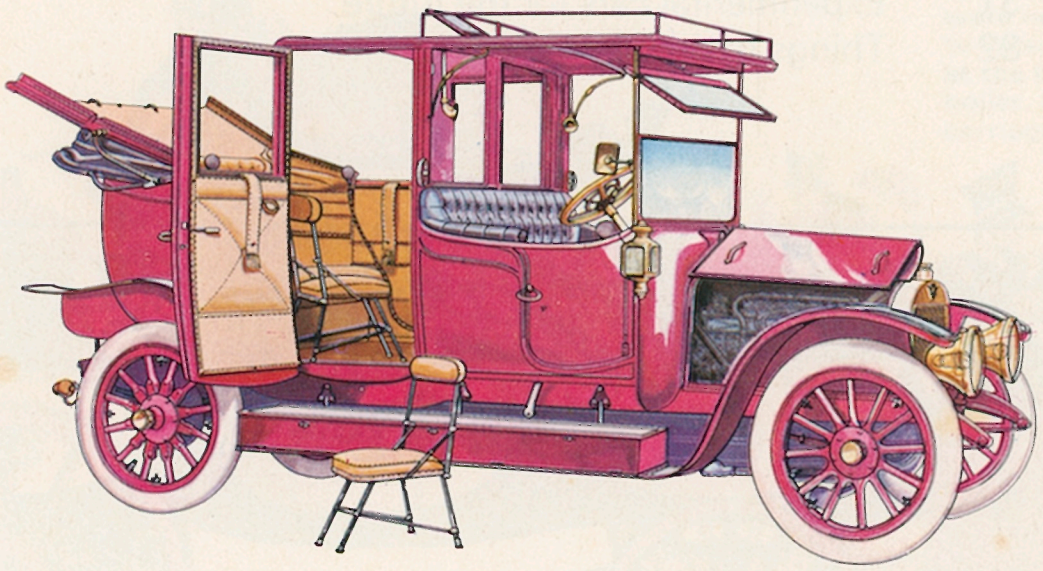

Macdonald

First published 1977
Macdonald Educational Ltd.
Holywell House, Worship Street,
London EC2

Adapted from *Cars*, published
by Macdonald Educational in
the Visual Books series.

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ISBN 0 356 05593 0

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Printed and bound by
New Interlitho, Milan, Italy

# Ancestors of the car

## The wheel is born

Thousands of years ago people lived in small groups in caves and huts and did not need to travel very far. When they did travel, they walked, or rode on horseback.

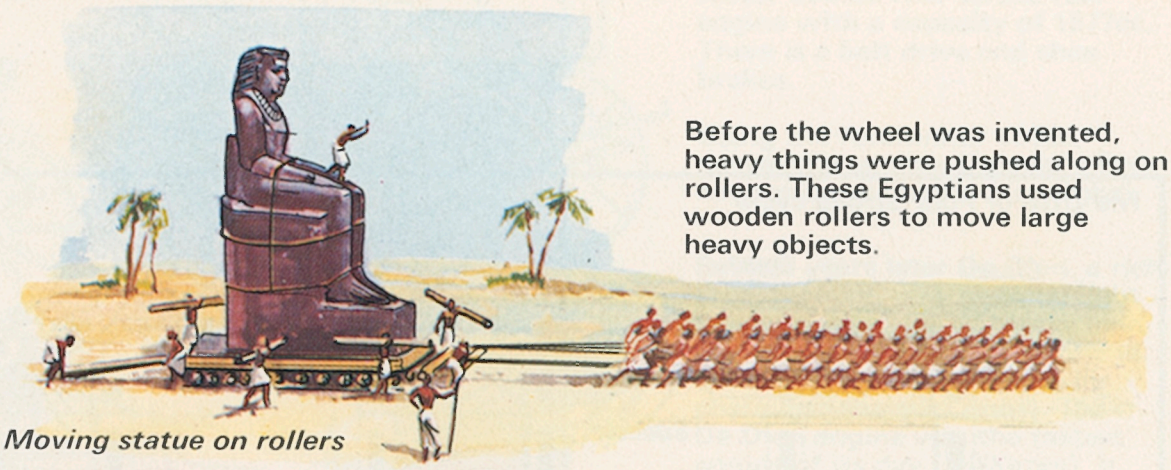
As the population grew, people began to sell things to other groups. They carried their goods on pack horses, and as they walked and rode they made tracks across the country and through the forests.

Trading increased and people wanted to carry more things over longer distances. So they began to use wheeled carts. No one knows who first thought of the wheel, but it was used a long time ago in China and Egypt. The wheeled carts made the tracks wider until they became roads.

## Steam engines

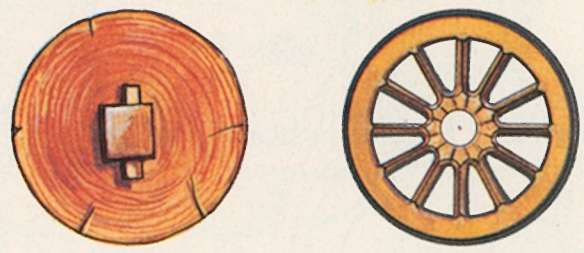
Wheeled carts were very slow, and rich people drove in fast chariots and carriages. Stage coaches ran between all the big cities. These horse-drawn vehicles were quite fast and could go ten miles in an hour (10mph).

The railway steam engine was introduced in about 1830. Trains were quick and comfortable, but they needed rails. Steam road vehicles could go anywhere there was a road, but they were heavy and slow. Someone had to make an engine that could do the work of a horse. It took a long time to find the right answer.



*Moving statue on rollers*

Before the wheel was invented, heavy things were pushed along on rollers. These Egyptians used wooden rollers to move large heavy objects.

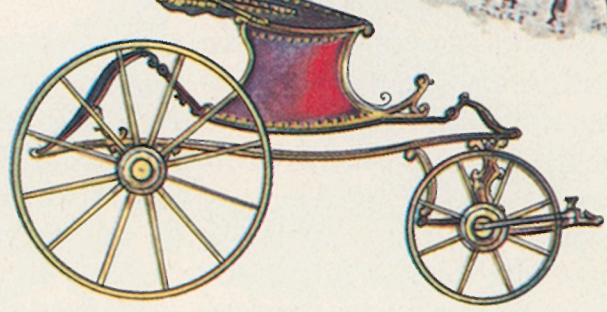


*Early solid and spoked wheels*

The first wheels were solid wooden discs. They were so heavy that the carts could not go very fast. Wheels with spokes used less wood, so they were lighter. The spoked wheel is also very strong.

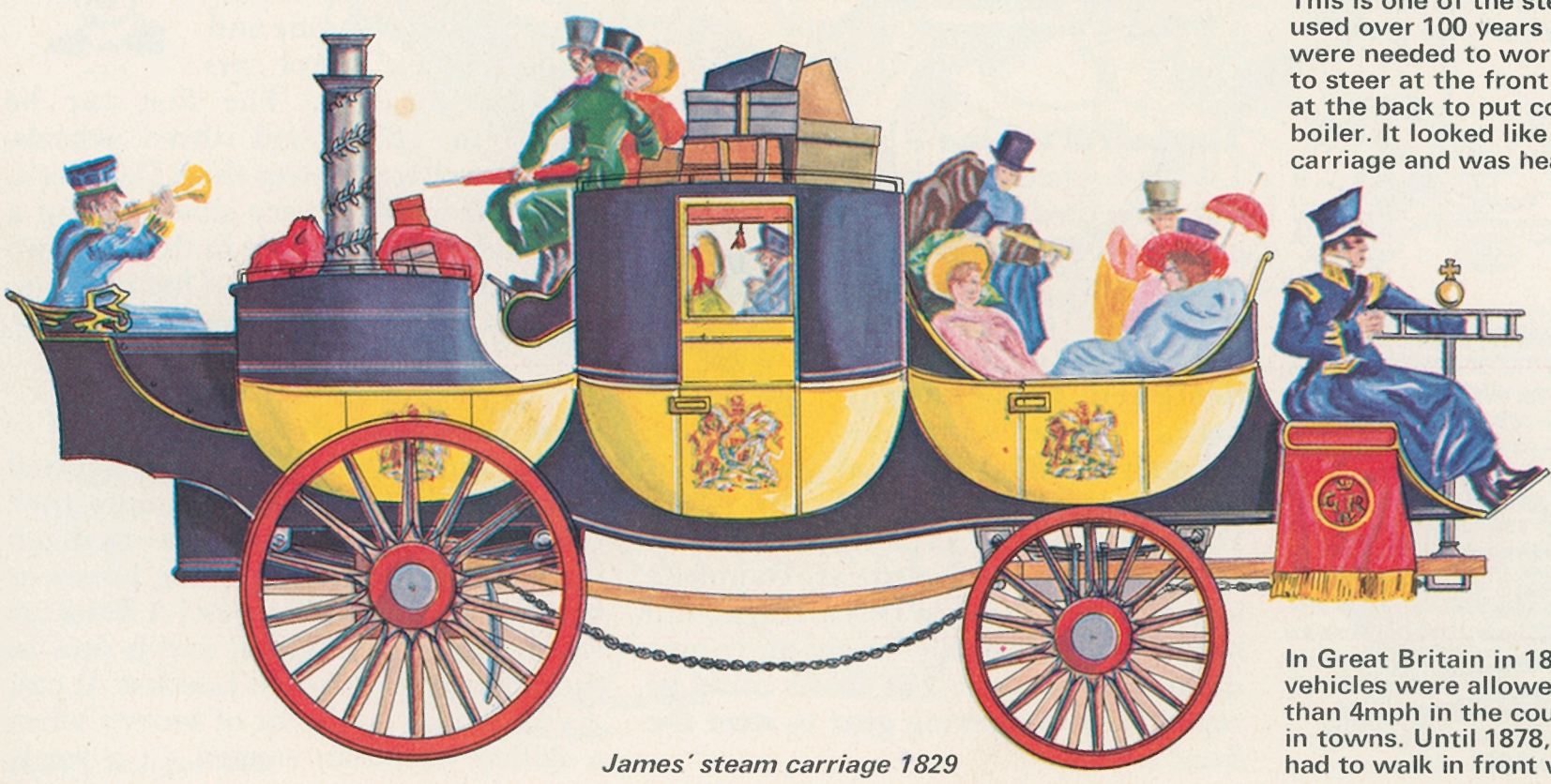
*Roman chariot*

The Romans fixed their chariots on to two wheels which were held in position on a wooden axle. The driver had to stand up or he would have been thrown out every time the chariot went over a bump.



*An early French suspended carriage*

A carriage used in France 200 years ago (left) is in two parts. The wheels are still on axles, but are fitted to a separate part called a chassis. The body is suspended from the chassis by leather straps, so that passengers do not feel the bumps.



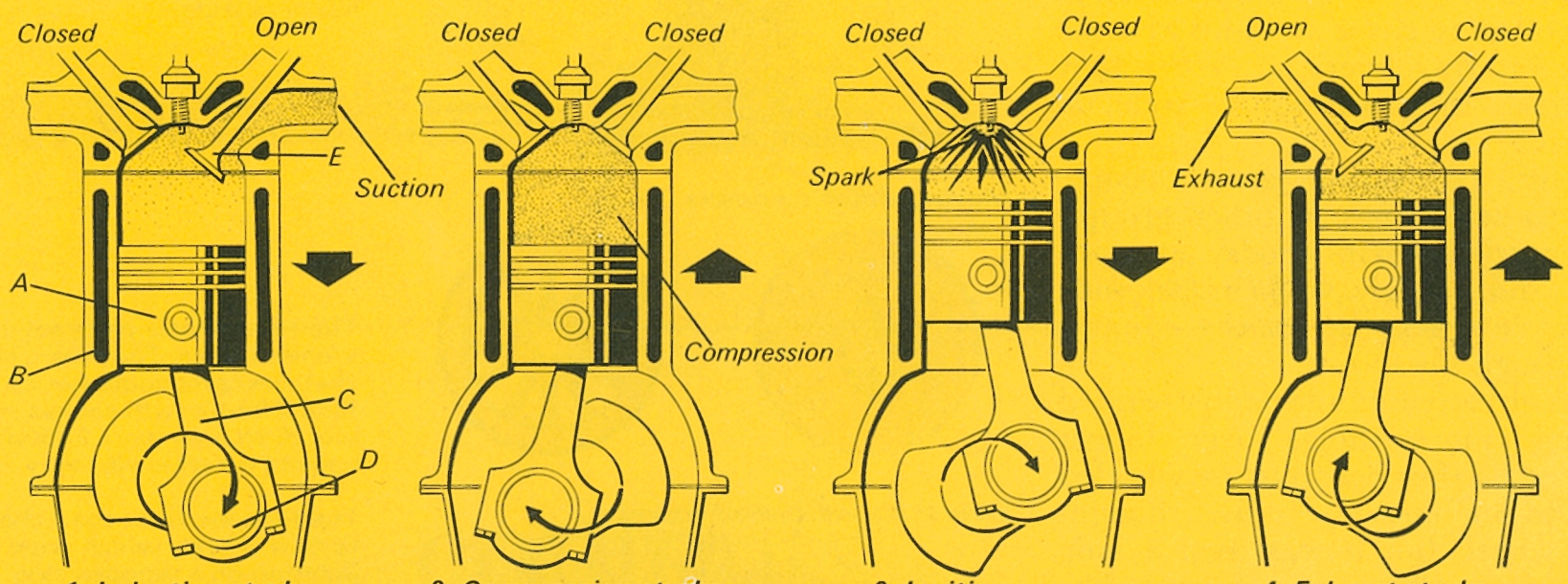
*James' steam carriage 1829*

This is one of the steam carriages used over 100 years ago. Two men were needed to work it: a driver to steer at the front and a stoker at the back to put coal into the boiler. It looked like a horse-drawn carriage and was heavy and slow.

In Great Britain in 1865, no steam vehicles were allowed to go faster than 4mph in the country or 2mph in towns. Until 1878, by law, a man had to walk in front with a red flag.

# **The petrol engine** four-stroke cycle

*The Otto or Four-stroke cycle*




*1. Induction stroke*

The Otto, or four-stroke cycle: A round metal piston (A) moves up and down in an iron cylinder (B). A metal connecting rod (C) connects the piston to the crank (D). The crank turns a heavy flywheel, and keeps the piston moving.

In the first stroke—the suction stroke—the righthand valve (E) is open. The piston, which fits tightly in the cylinder, comes down and air and petrol vapour is sucked into the cylinder. It is like sucking air into a bicycle pump by drawing back the handle.

*2. Compression stroke*

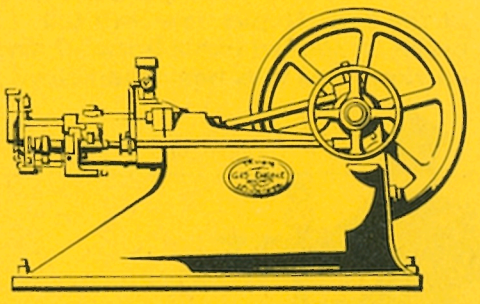
When the cylinder is full the valve shuts and the piston moves up for the compression stroke. The gas is squashed into a small space, or compressed, because it cannot get out. In this state it is highly explosive. When the piston gets to the top a spark lights the gas and it explodes. The expanded gas

*3. Ignition*

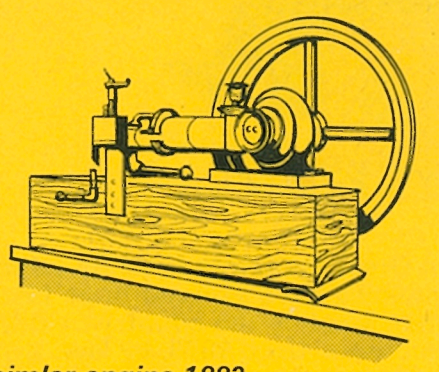
cannot escape so it pushes the piston down the cylinder to give the power stroke. Then the piston exhausts the waste gas. In the first engines this happened about 50 times every minute. A modern engine can turn round thousands of times a minute.

*4. Exhaust stroke*

**Gas engines were sometimes used to drive machinery. A piston moved up and down in the cylinder and a crank changed this action into a circular motion. These engines did not compress the gas, so were slow and low-powered. However, in the 1870s, when Otto, a German, worked out a four-stroke cycle. Now the piston made four separate movements, or strokes, with different jobs being done with each stroke. The same idea is used in the petrol engines of nearly all cars today.**



*Gas engine using Otto Cycle 1880*



*Daimler engine 1883*

## The gas engine

By 1860 Lenoir, a Belgian, was making and selling engines that ran on gas. In 1863 he fitted one in a car which he drove for six miles around Paris. The journey took between two and three hours, because his engine was very slow. It could only turn a hundred times in a minute. Marcus, an Austrian built a crude four wheeler in 1864; his 1874 car could travel at 5mph.

## The petrol engine

Like the wheel, the petrol engine was not invented by one man. Many engineers and inventors were working on the idea. Daimler was a German engineer. He built Otto engines and designed a successful petrol engine with one cylinder in 1883. It ran at 900 revolutions per minute (rpm). In 1885, Daimler built an experimental motor cycle and a four-wheeled car. Daimler's idea was to convert horse carriages into horseless carriages by fitting an engine under the carriage. The shafts could be replaced by a steering gear to steer the front wheels.

*Daimler*

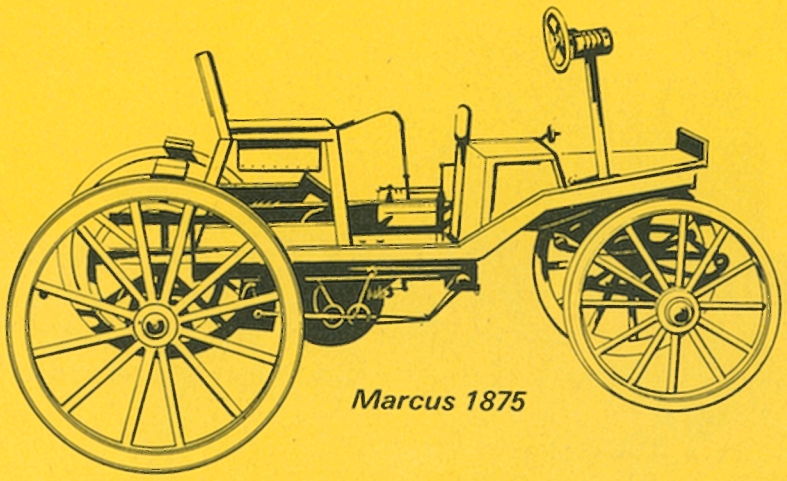
Daimler produced the first high-speed petrol engine in the world, and many other makers used it. Emile Levassor, in France, was one. In 1891, his firm began building *Panhard et Levassor* cars which makers all over the world imitated for the next ten years.

*Benz*

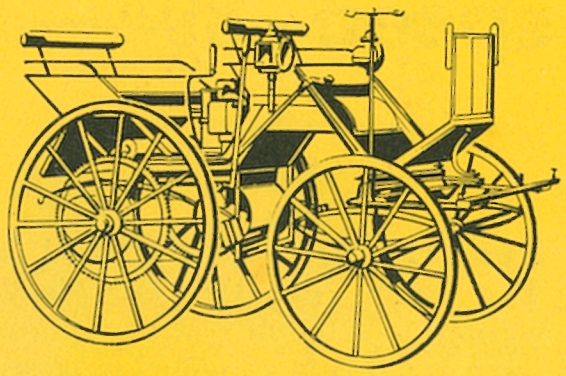
Benz, the son of a German engine-driver, was an exception. He invented his own engine and made the first petrol cars designed for sale. The first car he made, in 1885, had three wheels. The engine was slower than Daimler's. It would only go very slowly along a flat road. Cars he made in the next two years were much better. One of them, made in 1887, had a top speed of 12mph.

## First cars for sale

A Frenchman, Roger, first marketed Benz cars in 1888. It was some time before the cars could be used on the roads without frightening horses or being chased by policemen! A Benz car was brought to England and is now in the Science Museum in London. It cost £130, which was a lot of money when a skilled workman earned £1 a week.



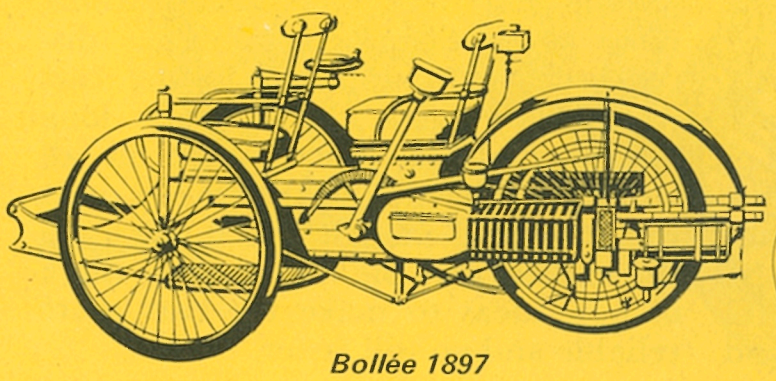
*Marcus 1875*



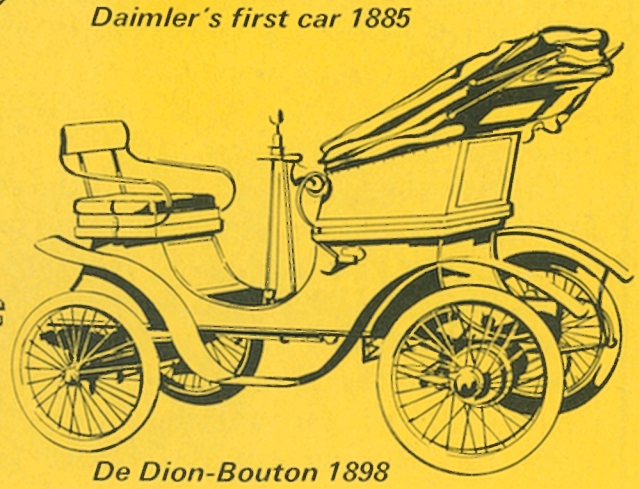
*Daimler's first car 1885*

The *Marcus* (top left) was an Austrian built car of 1875. It has a water-cooled four stroke rear engine with a capacity of 1577cc. There is a belt drive and shoe brakes.

Using the forerunner of his successful engine, Daimler's first car appeared in 1886 (top right).

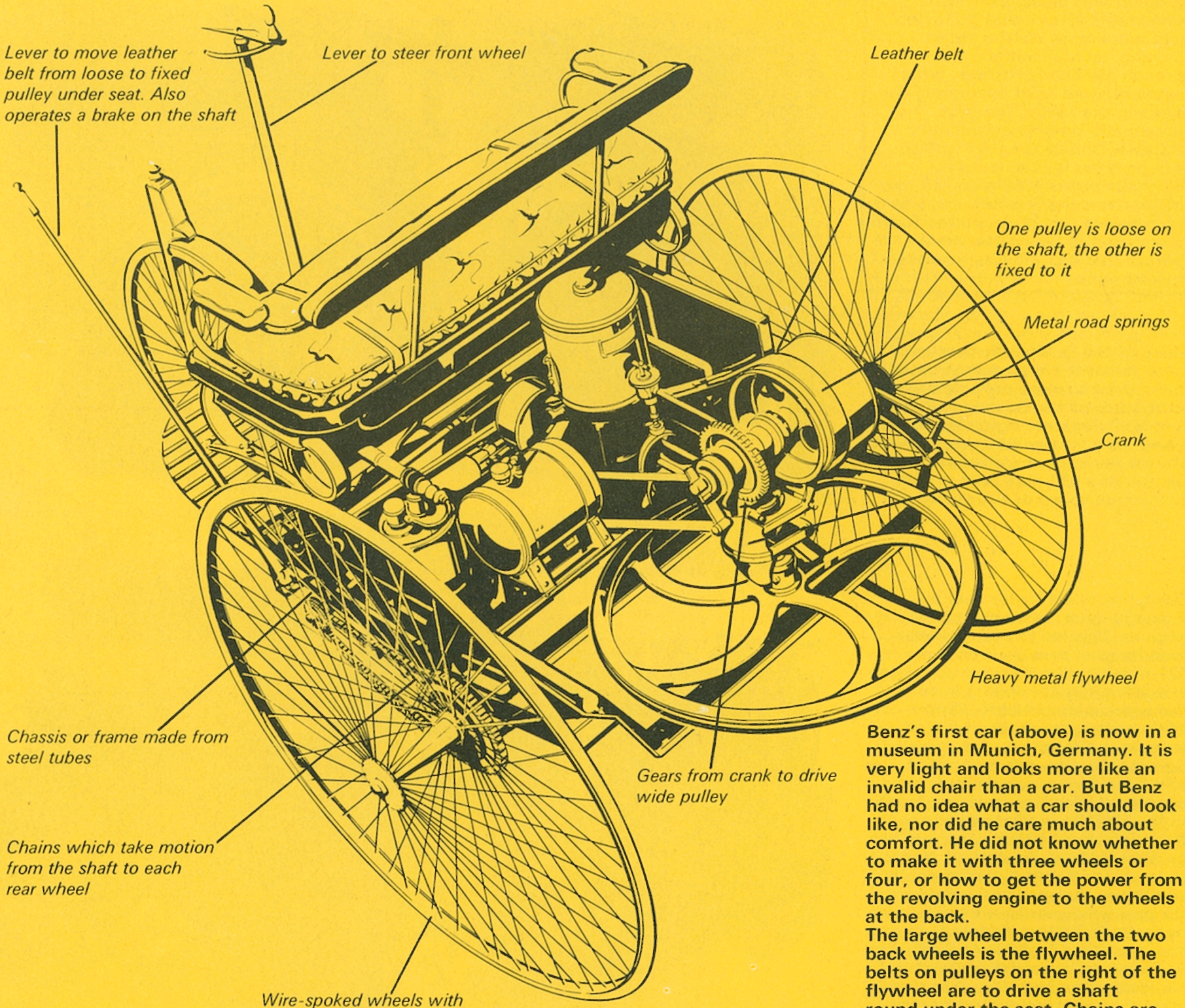


*Bollée 1897*



*De Dion-Bouton 1898*

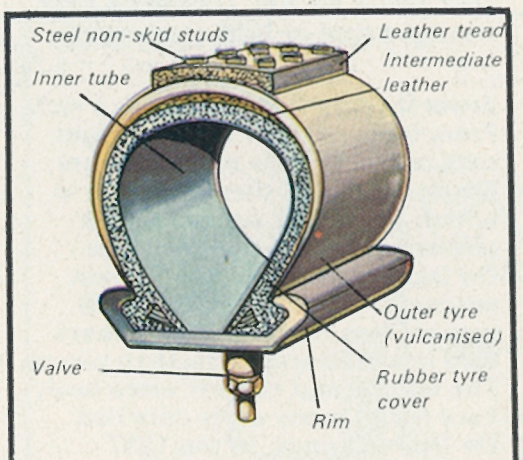
Several years later De Dion, a rich French count, was building light cars with the help of his partner, Bouton. In 1898 they built one in which the driver sat facing his passenger (bottom right). The De Dion engine was the fastest engine of its day (2,000rpm). It was so fast that other engineers said it would shake itself to pieces. The engine and the car were both very light: many early cars had De Dion engines. In the 1897 *Bollée* (bottom left) a passenger sat in front of the driver, and there was only one wheel at the back. It had pneumatic tyres, and three gears. A flat belt was used to drive the wheels instead of a chain.


Lever to move leather belt from loose to fixed pulley under seat. Also operates a brake on the shaft
Lever to steer front wheel
Leather belt
One pulley is loose on the shaft, the other is fixed to it
Metal road springs
Crank
Heavy metal flywheel
Chassis or frame made from steel tubes
Gears from crank to drive wide pulley
Chains which take motion from the shaft to each rear wheel
Wire-spoked wheels with solid rubber tyres

*Benz's first car 1885*

Benz's first car (above) is now in a museum in Munich, Germany. It is very light and looks more like an invalid chair than a car. But Benz had no idea what a car should look like, nor did he care much about comfort. He did not know whether to make it with three wheels or four, or how to get the power from the revolving engine to the wheels at the back.
The large wheel between the two back wheels is the flywheel. The belts on pulleys on the right of the flywheel are to drive a shaft round under the seat. Chains are fixed to each end of this shaft, one to drive each rear wheel.

# The race for speed 1894–1905




*Early pneumatic tyre*

**The very first cars had wooden wheels with iron tyres. Then came solid rubber tyres, which were not so noisy and did not skid on the roads. Finally, the pneumatic tyre (above) was made. Cars with pneumatic tyres could go faster and were more comfortable. Dunlop, an Irish vet and the French Michelin brothers, both experimented with pneumatic car tyres in the 1890s. The first pneumatic tyres were not very reliable. One of the first cars to run on them was entered by Michelin in the 1895 race. No one knows how many punctures had to be repaired but 22 new inner tubes were used. It was some years before this type of tyre was used by everyone.**

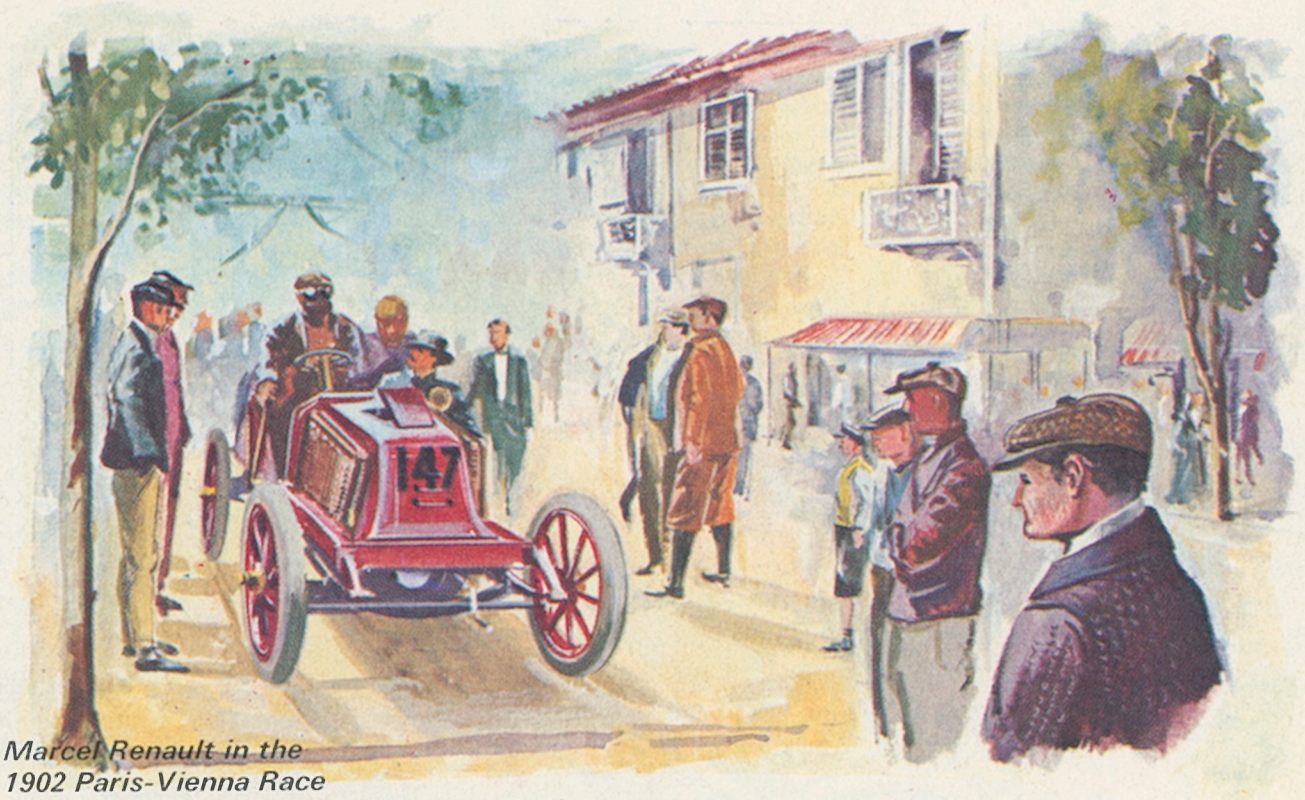
## Road races

The early inventors and engineers wanted to show people that motor cars were reliable and fast. So races were held to try to get the public interested in cars. The races were run on roads, as rallies are today, and race tracks were not used until later.

In July 1894, Giffard, the editor of a French newspaper, organised a race for horseless carriages over 79 miles of roads between Paris and Rouen. Thirteen cars took part in the trial. The race was won by the Comte de Dion in his steam car at an average speed of 11·6mph. Racing could be fun, and it did rouse public interest, but it could be dangerous. Levassor had a very bad accident when his car collided with a dog, and he died soon afterwards.

## Finding faults

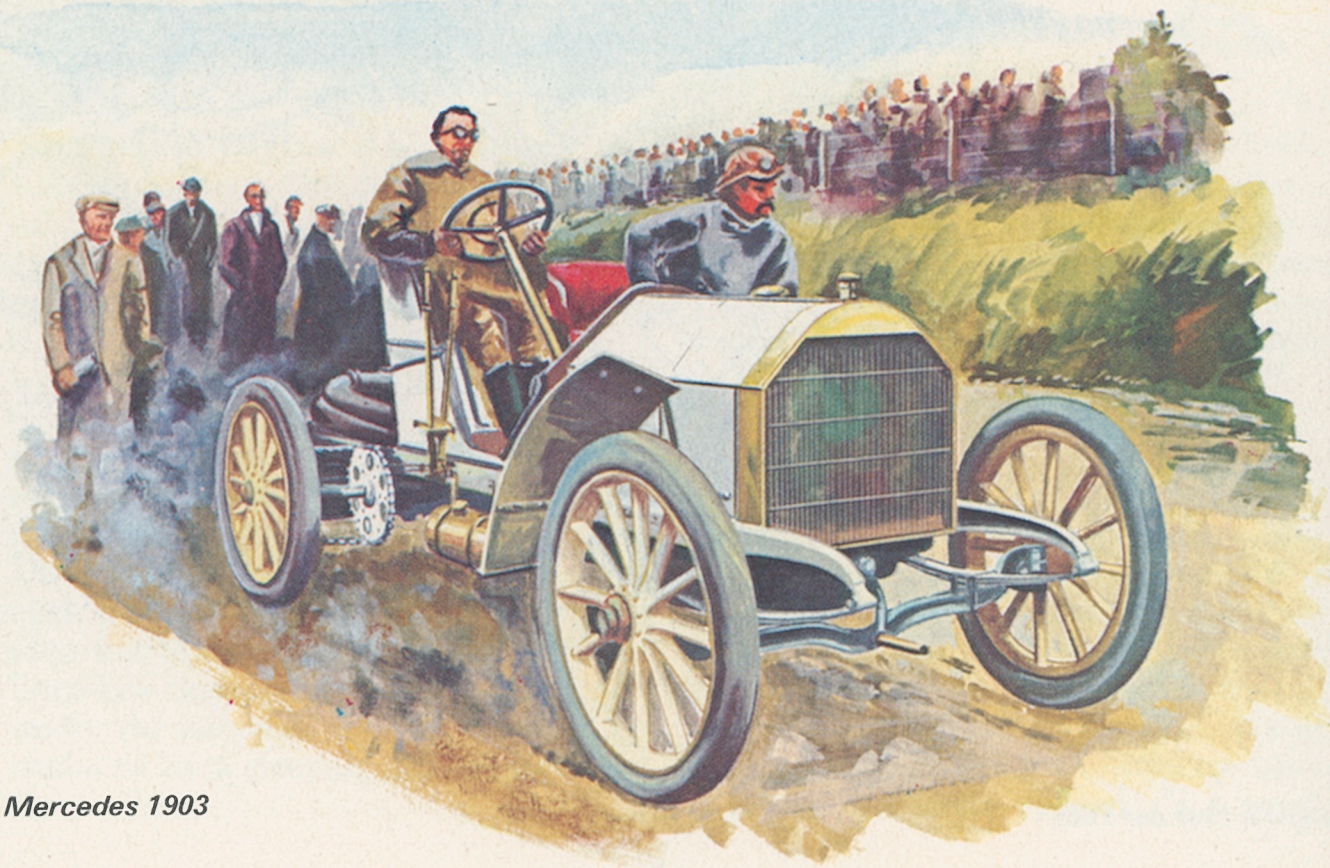
All the time the drivers were learning more about their vehicles. They discovered what happened to the cars when they were driven over long distances at maximum speed in all weathers. They found that many parts were not good enough, and it was up to the makers and the inventors to think of new ideas to make the cars more reliable and go still faster.



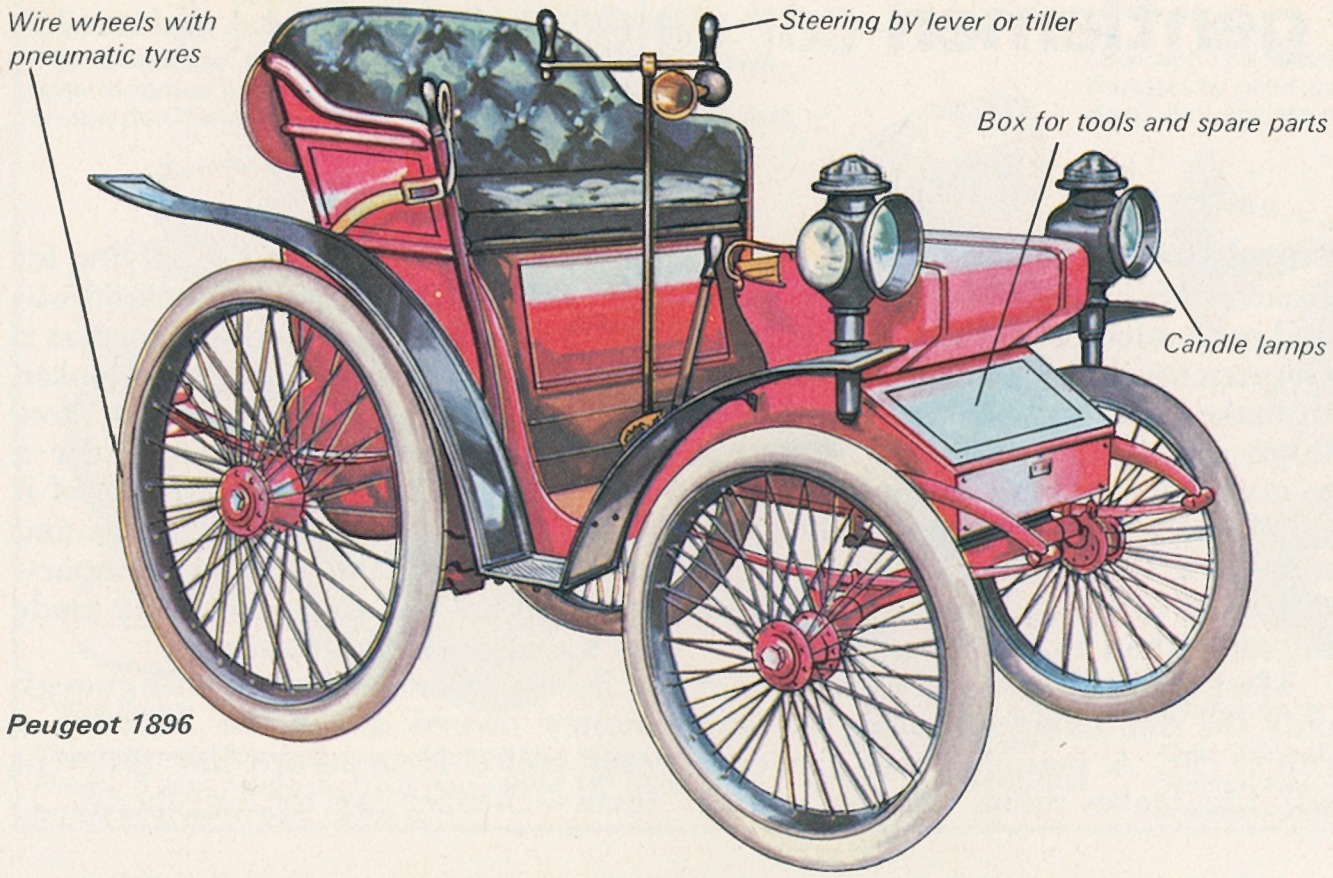

*Marcel Renault in the 1902 Paris-Vienna Race*

Many of the cars in the first road races failed to finish and of those that did some were only able to do so because of the drivers' skill. One 1902 *Renault* (right) however, looked as if it was built for speed. Marcel Renault won the light car section of a 620-mile race in it at an average speed of nearly 40mph.

Designers made faster cars by making bigger, more powerful engines. This led to more modern-looking cars. Jenatzy won the 327-mile Gordon Bennett Cup race in a *Mercedes* car (right) at an average speed of nearly 50mph. With such high speeds, it is not surprising that there was trouble. Spectators were not controlled and dogs, horses, cattle and people wandered all over the roads. In the 1903 Paris-Madrid race Louis Renault ran over four dogs, and his brother, Marcel, was killed. Newspapers called it the 'race of death', and it was stopped at Bordeaux, the cars being sent back to Paris by train. Gabriel in a *Mors* had averaged an incredible 65·3mph to Bordeaux, a speed few drivers could equal today. Now that there were fast, reliable cars, the next step was to make them easier to drive, safer and more comfortable.

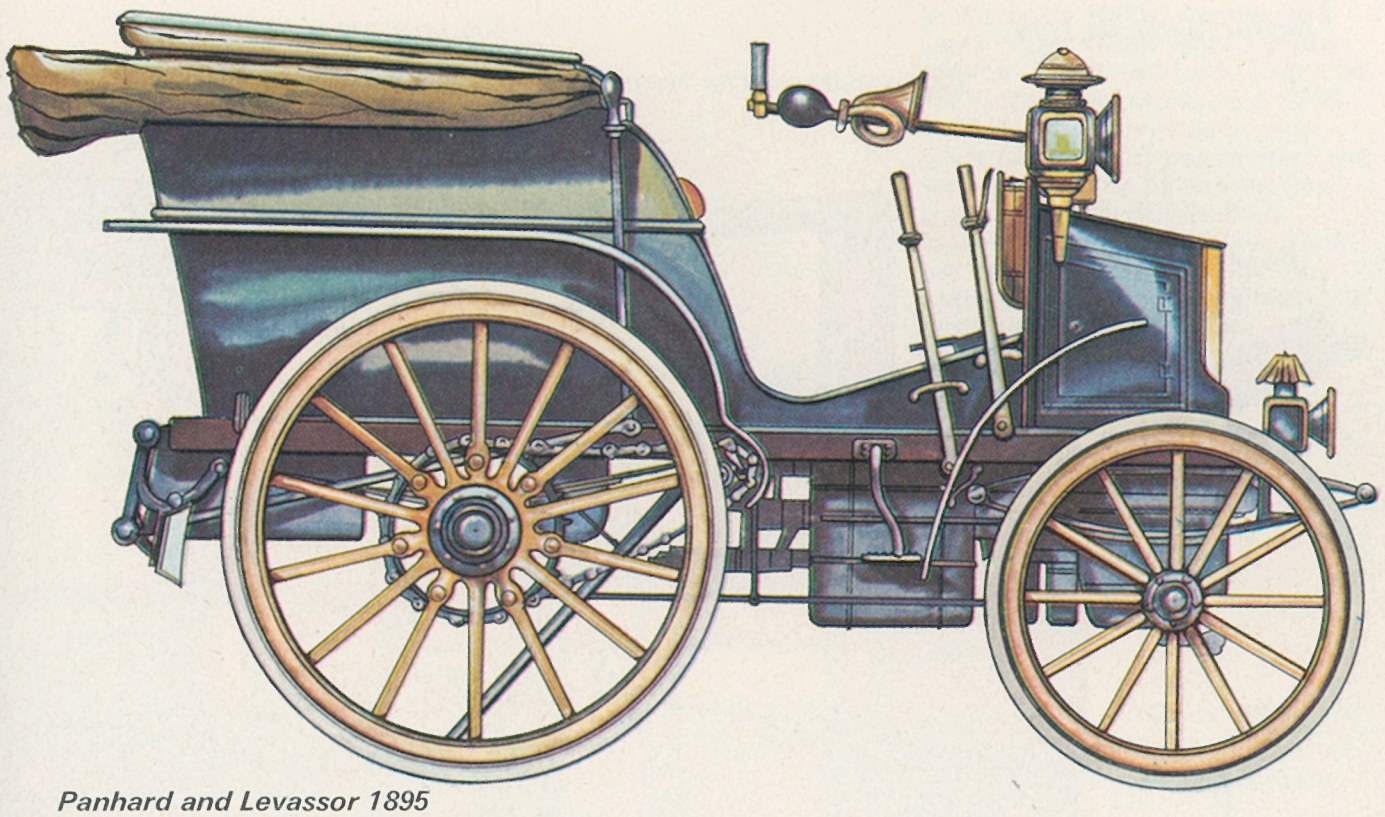


*Mercedes 1903*



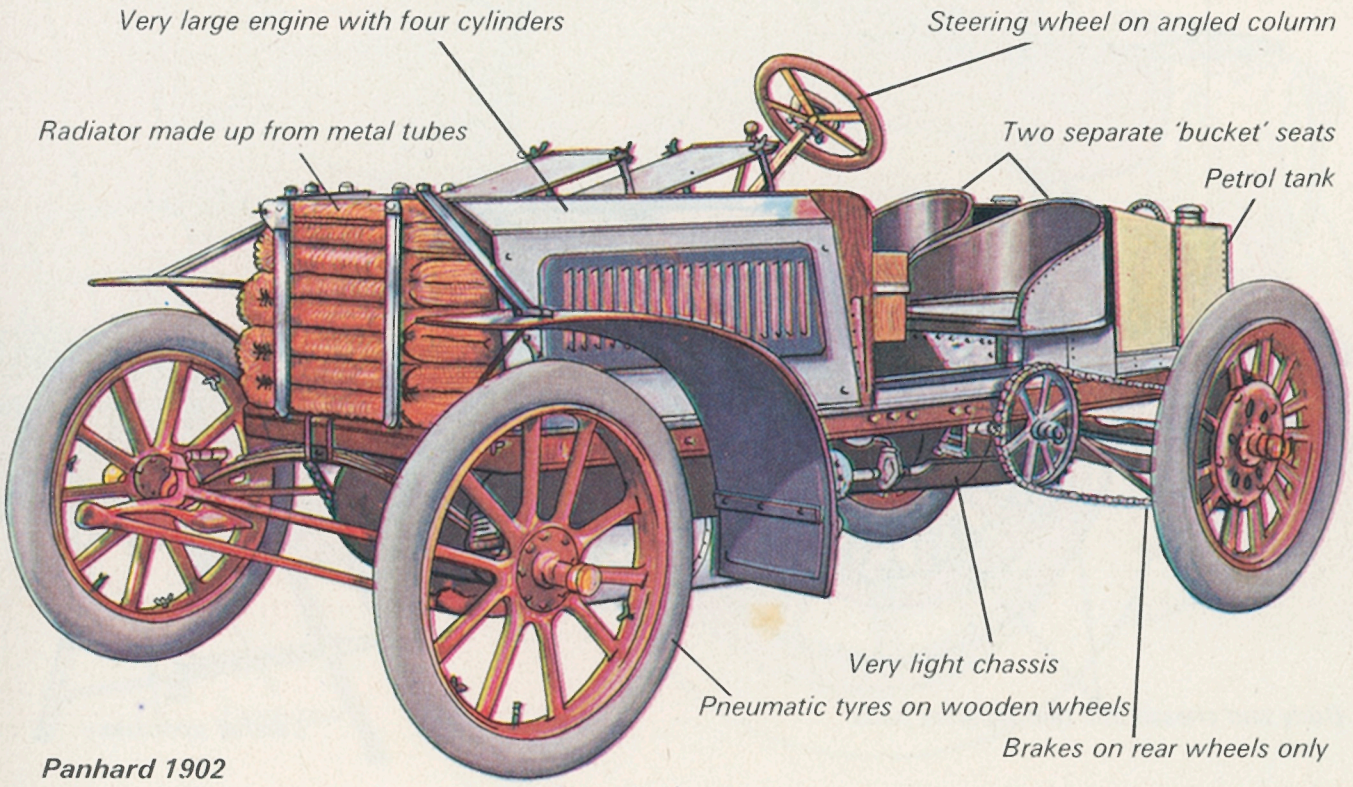

*Peugeot 1896*

The *Peugeot* (left) took part in races in 1896. Like many of the petrol cars at that time, it still had the shape of the light horse-drawn carriages. A small engine was placed under the seat and the driver and passenger sat high up in the car.
Although the *Peugeot* had pneumatic tyres and good springs, the brakes were not very good and the steering was hard to control. All the shocks from bumps on the roads came up the steering column to the tiller bar. There was no steering wheel, and the driver had to hold the tiller very tightly to stop it jumping out of his hands. This was difficult when changing gear, and operating all the levers. Little could be done to make cars like this go very much faster. New ideas were still needed.



*Panhard and Levassor 1895*

The 1894 race was so successful that in the following year the first French Grand Prix was run. It ran for 732 miles, from Paris to Bordeaux and back again.
Eighteen vehicles set off and the first one back was a *Panhard et Levassor* (left), driven by the inventor Emile Levassor. He drove all the way himself for more than 48 hours, with only a few very short stops. His car had a two-cylinder petrol engine and solid rubber tyres and reached a top speed of only 18mph on a flat road. The average speed was 15mph.


Very large engine with four cylinders
Steering wheel on angled column
Radiator made up from metal tubes
Two separate 'bucket' seats
Petrol tank
Very light chassis
Pneumatic tyres on wooden wheels
Brakes on rear wheels only

*Panhard 1902*

In 1902 the *Panhard* (left), driven by Charles Jarrott, won the Circuit of Ardennes in Belgium at 54mph.
The engine, which takes up more space than anything else, is at the front, as it is in most modern cars. The drive is fed to the rear wheels by chains, and through a gearbox under the seats.
The wooden wheels and chassis had to be much stronger to carry the weight, yet this was one of the lightest racing cars made at the time. Comfort was still not very important in racing cars, and the drivers had to be strong, as well as brave. The roads were made up only from stones and earth. Thousands of horses were still being used, and they made the road surface even rougher.

# **Motoring for gentlemen** car sales until 1914

**FACTS AND FIGURES**
**In 1904 a car cost about £600 to buy and about 2p (5d) a mile to run. A big heavy car cost much more, because tyres did not last very long and were very expensive to replace. In 1908 there were about 40,000 cars in use in Britain, and 8,000 new cars were made. The number of cars on the road had risen to 100,000 by 1913. In the USA there were 24,000 in 1905. Americans could even buy them on hire purchase. Only the rich, however, could afford a car. Some even had a chauffeur, who earned £1·50 a week plus his food. Every Royal family in Europe had a car by 1913.**

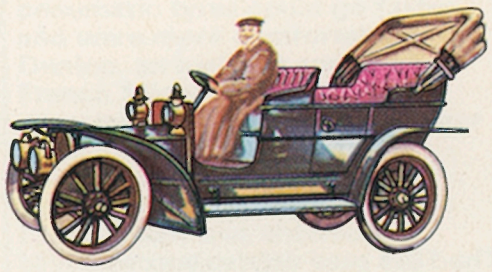
## Supply and demand

Road trials and the Continental races had persuaded people to accept the car. German inventors had worked out how to make cars go, and the French had taken up the idea and were beginning to make cars to sell in bigger and bigger numbers. Up to 1900 probably 4,000 motor cars had been sold. By 1913 dozens of manufacturers were producing more than 1,000 cars a year.

Most of the cars were for gentlemen: only the rich could afford to buy and run a car. A manufacturer can only sell if he makes things that are needed or wanted. This is called supplying for the demand. The greatest demand was for the gentleman's carriage, so that is what was made. Cars no longer looked like horse carriages with engines. Now the engine was at the front under a bonnet, with a radiator in front of it and a dashboard behind. Drivers and rear passengers sat in separate compartments in a wood and metal body made by the most skilled craftsmen.

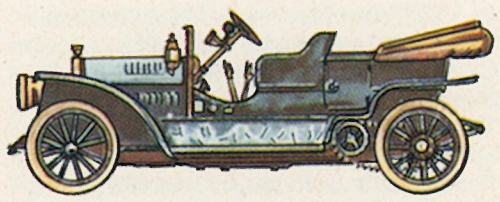
By 1913 almost everyone with enough money owned a car. In America a man called Henry Ford had different ideas—cheaper cars for everybody.

*Peugeot 1905*



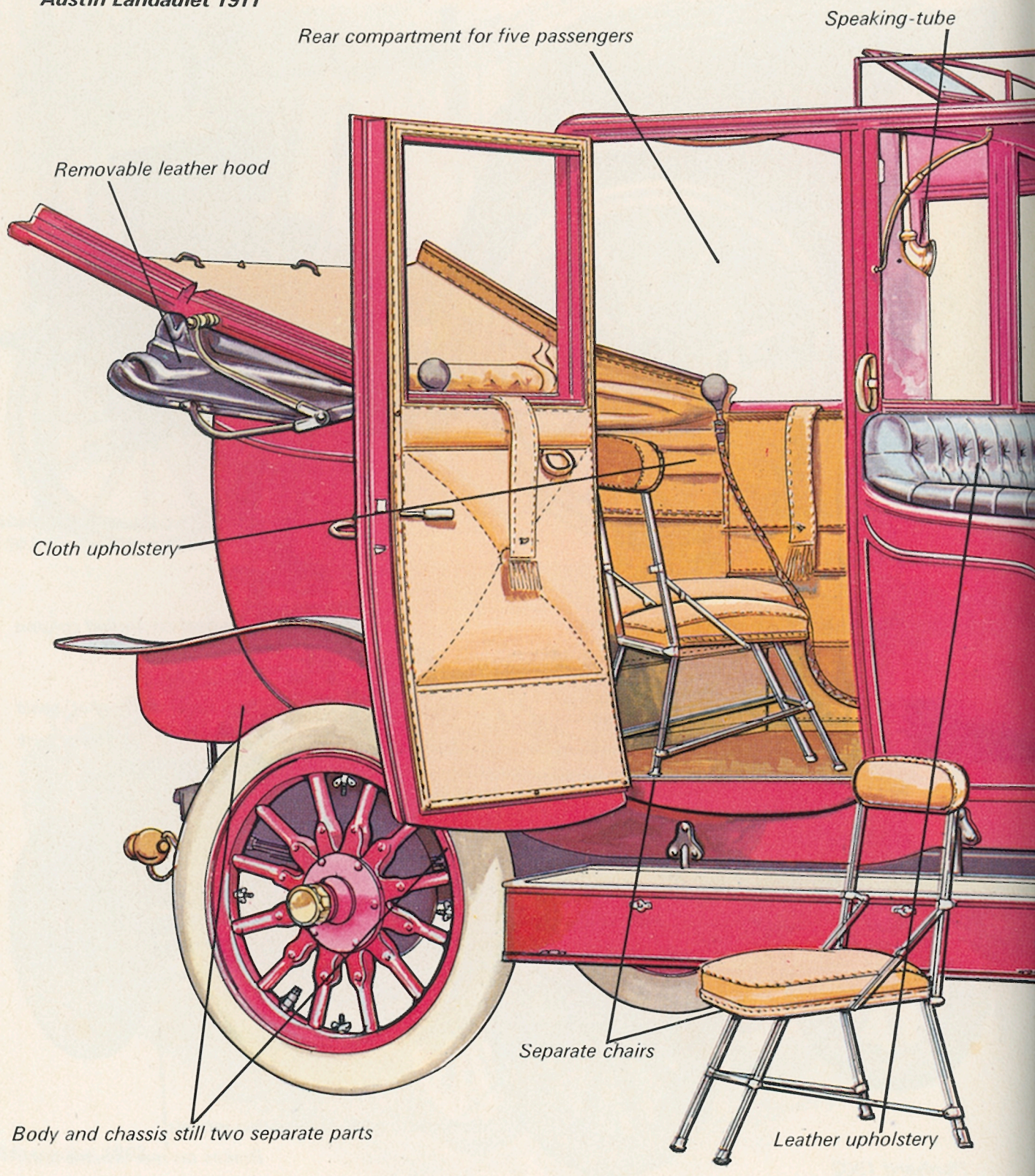
The King of Portugal drove a *Peugeot* in 1905 (above). There was no glass windscreen to protect him from wind and rain, so he wore a long waterproof coat. Most people also wore goggles to keep the dust out of their eyes. The front and back parts of the body were still separate, and the front did not have doors. The passengers got into the rear by standing on the running board and then on to the other little step. The large hood at the back could be raised in bad weather, but it did not stop the rain blowing in at the sides and at the front.

*Benz 1907*



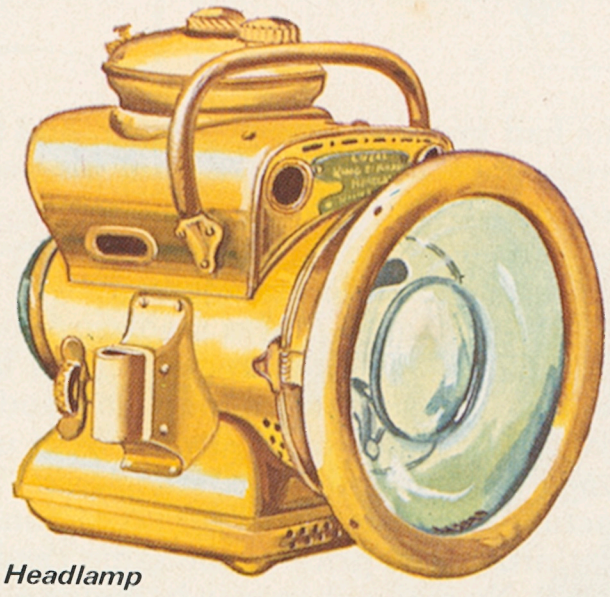
By 1907, *Benz* cars (above) were much bigger than the first one made twenty years before. They still looked like the *Peugeot,* as did most cars made for the rich at that time. The 1907 *Benz* did have a glass windscreen, however. By this time, they also all have pneumatic tyres except in rural America. A bulb horn was fitted to the steering column. The top part of the shiny brass radiator at the front of the engine is also visible. This car could go faster than 60mph.

***Austin Landaulet 1911***



## **Motoring Accessories** from a catalogue of 1909.

The *'Contessa' Motoring Hood* described as the latest idea in ladies headwear. 'In best quality Silk or Crepe de Chine, with Lace Veil and Mica front.' (Right).



*Headlamp*

This splendid headlamp was called the *'King of the Road'*. It was made of brass and stood 12" high. It burnt acetylene gas. (Above).

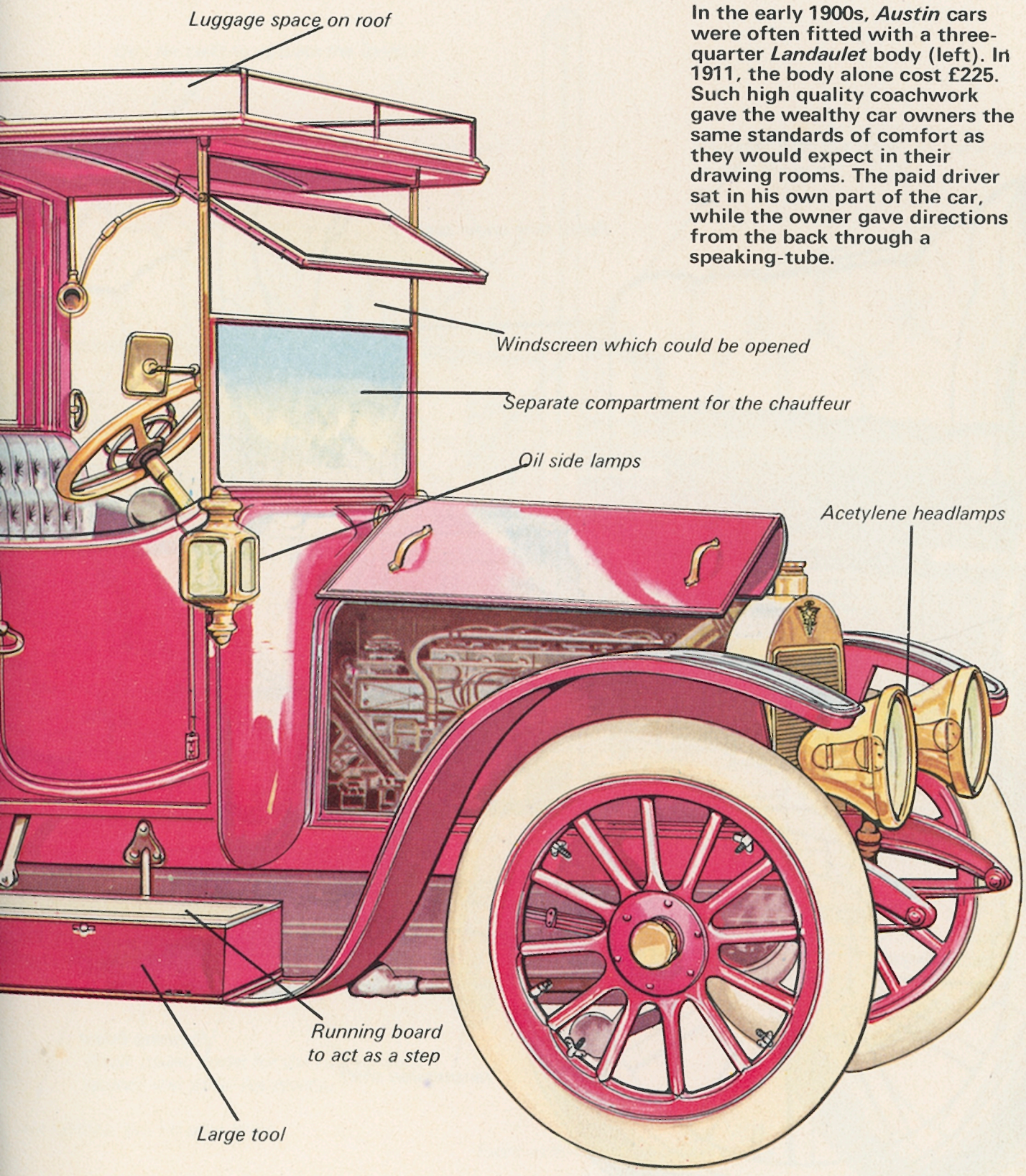
*Ladies' hood*

*Man's travelling cap*

(Below) The *'Multi-twist'* was described as 'A very handsome production'. Its multi-spiral form gives a deep rich cornet note; loud, prolonged and effective.

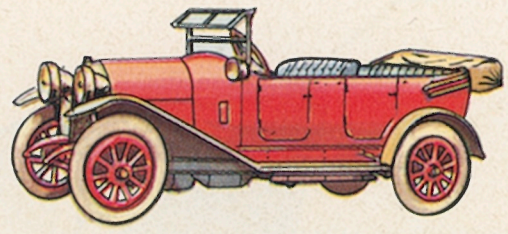
*Motor horn*

This *'Travelling Cap'* is one of *'Dr. Jaeger's Specialities in Hats and Caps'*. 'It is fleecy knitted, and very warm and comfortable.' (Left).


Luggage space on roof
Windscreen which could be opened
Separate compartment for the chauffeur
Oil side lamps
Acetylene headlamps
Running board to act as a step
Large tool

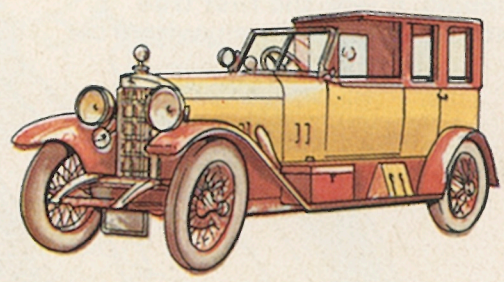
In the early 1900s, *Austin* cars were often fitted with a three-quarter *Landaulet* body (left). In 1911, the body alone cost £225. Such high quality coachwork gave the wealthy car owners the same standards of comfort as they would expect in their drawing rooms. The paid driver sat in his own part of the car, while the owner gave directions from the back through a speaking-tube.

*Fiat 1914*



The 1914 Italian *Fiat* (above) had electric lights and a windscreen. It is an example of a touring car with four doors. The shape of the body, like the *Mercedes,* looks as if it is made from one piece of metal. It was longer and thinner than earlier cars, and was called a Torpedo body. The front part is no longer separated from the back, so the driver felt he was in the same car as his passengers. Many car owners enjoyed driving, so did not use chauffeurs.

*Mercedes 1914*



In the big 1914 *Mercedes* (above), the old oil lamps at the side have gone, and large electric lamps are put at the side of the radiator instead of the acetylene gas lights.

The bodywork has now become enclosed. Even the wings look as if they are a part of the body. The bonnet, scuttle and body are in line as if they are made in one piece. The back part of the body is for the passengers and is waterproof. The front door is on the driver's side.

# **The first popular car** the Model 'T' Ford

Henry Ford was the first man to make motoring possible for almost everybody in America. He did it with his *Model 'T'* car. His slogan was 'reliability and low cost'. The name Ford has been famous ever since.

**Record sales**

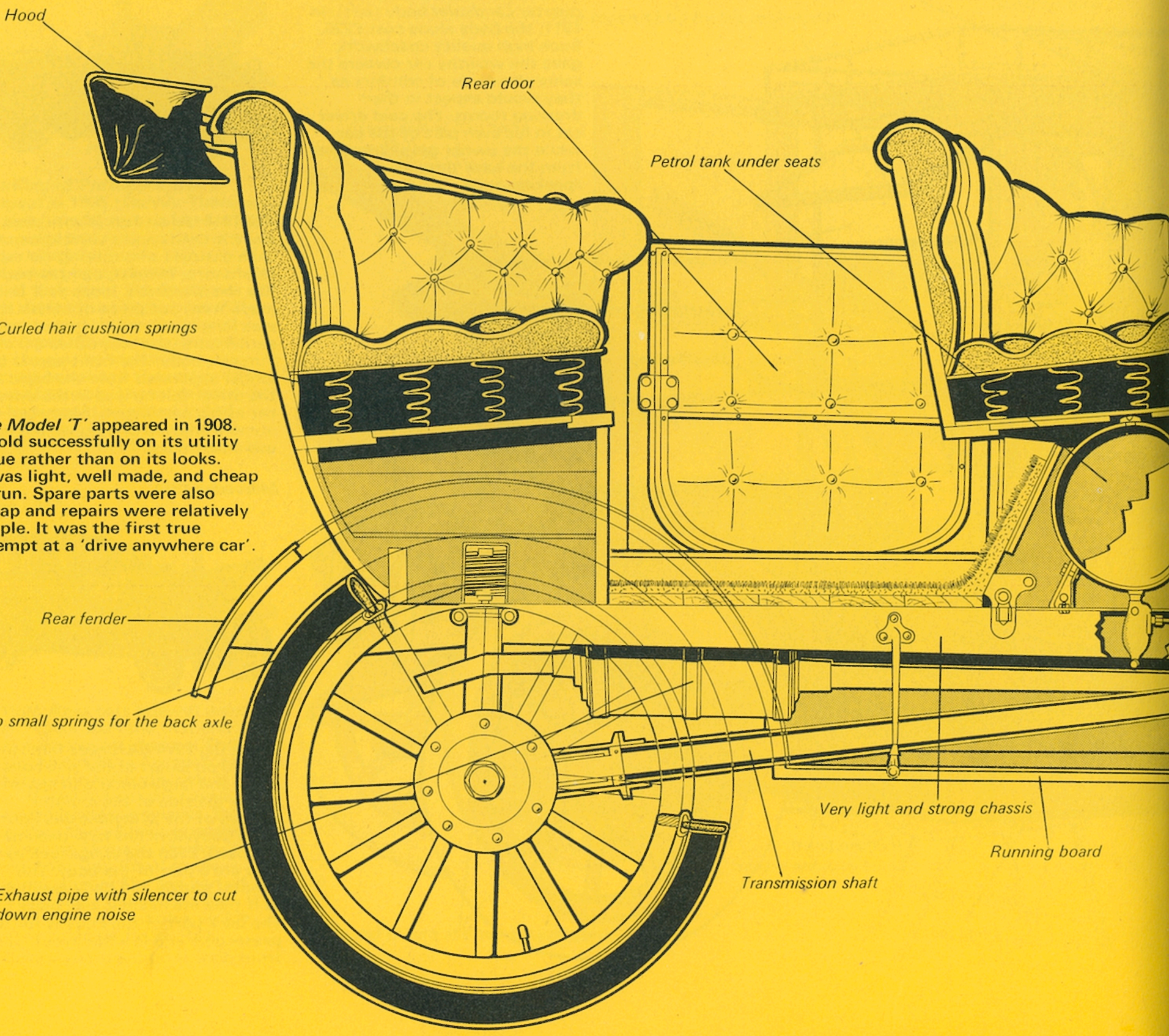
When the last *Model 'T' Ford* was produced, in 1927, 15 million of them had been sold. The only other car to be manufactured in anything like the same numbers is the *Volkswagen*. It exceeded the *Model 'T'* record in 1972.

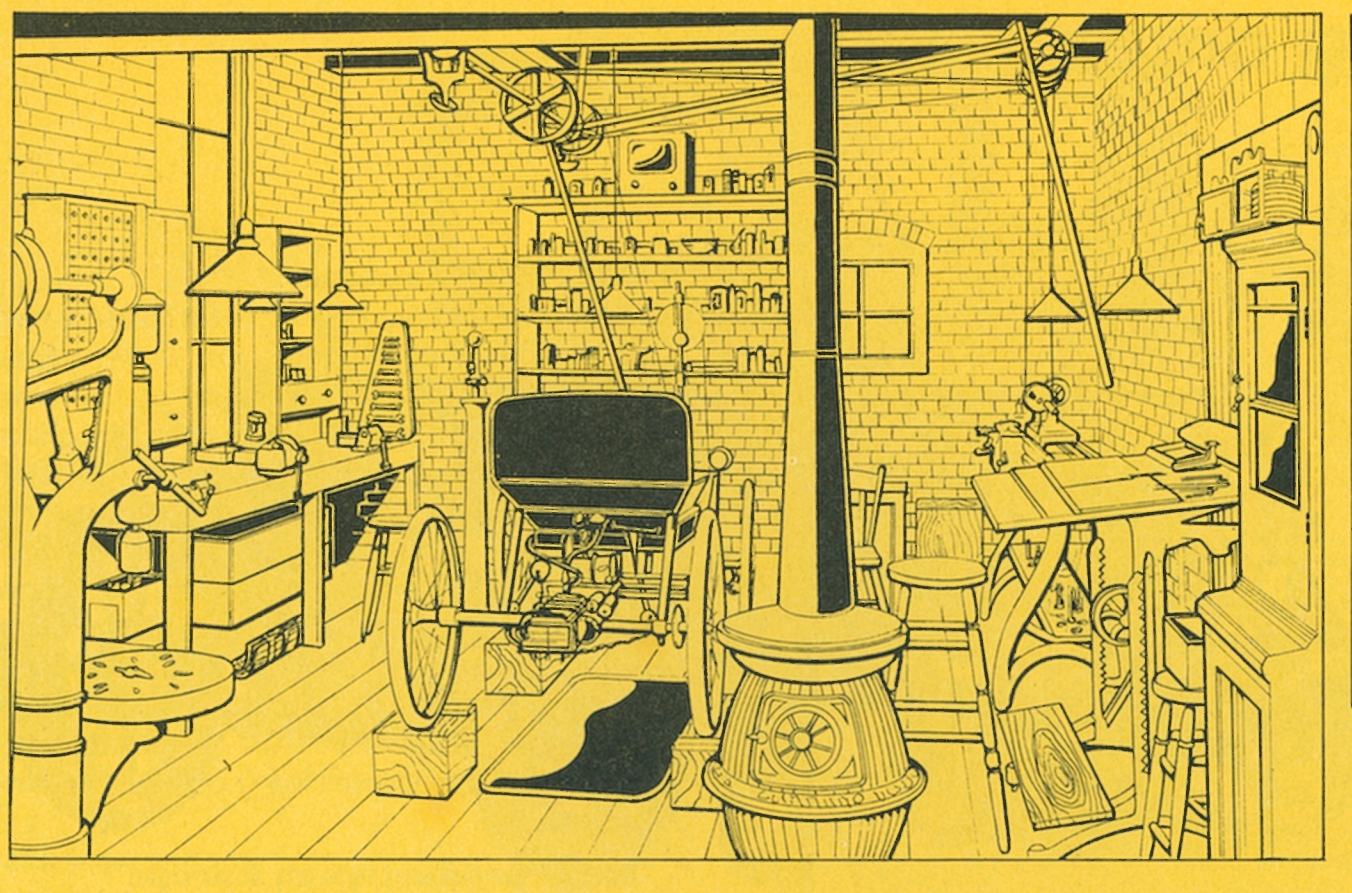
Henry Ford was born in America in 1863. His father was an Irishman who had gone to America to be a farmer. Henry wanted to be a mechanic, so when he left school at 16 he went to work in a small factory. Later he repaired farm steam engines. The unsuccessful tractor he built, in the 1880s, was driven by steam. In 1896 he had made his first petrol car, and in 1899 gave up his job to form his own company.

**Mass production pioneer**

The first *Model 'T'* was made in 1908, and it was the first car to be built by modern mass production methods. While the price of most cars went up each year (and still does), the *Model 'T'* actually went down. In 1927 it cost only a third of the price of the same car in 1908. No major change in its design was made in all those years. People called it the 'Tin Lizzie', but this did not stop them from buying it—and loving it.

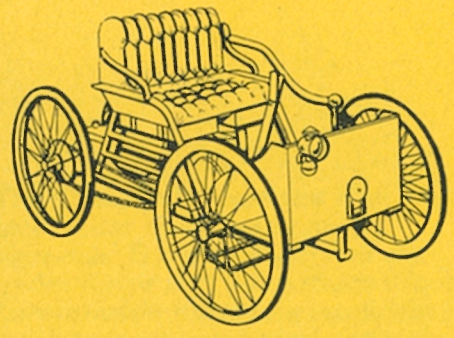
*The Model 'T'* appeared in 1908. It sold successfully on its utility value rather than on its looks. It was light, well made, and cheap to run. Spare parts were also cheap and repairs were relatively simple. It was the first true attempt at a 'drive anywhere car'.





Henry Ford's first workshop at 58 Bagley Avenue, Detroit, US. 1896 (left).

*Henry Ford's first car, 1896.*



Henry Ford's first car was built in 1896 and was described by him as a quadricycle. It was powered by a twin-cylinder four stroke engine mounted at the rear. The car's weight was only 4½cwt and it ran for 25 miles on a tankful of petrol.

*Box for coils to operate the ignition*

*Dashboard*

*Radiator, with fan driven by the engine to cool the water*

*Piston*

*Slow-running engine with four cylinders. The engine only turned at 1,500rpm and this is one reason why the car lasted for such a long time. Top speed about 40mph.*

*Fan*

*One spring across the front*

*Crankshaft*

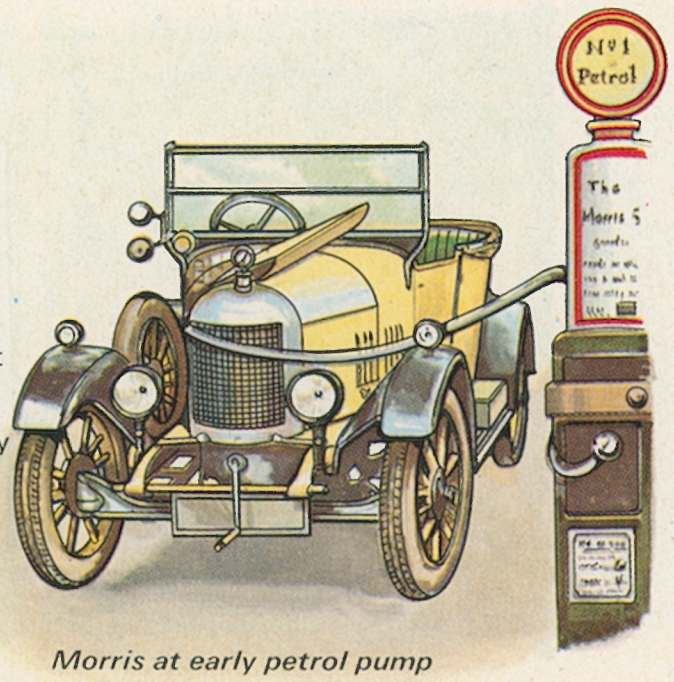
*Brake pedal, pedal for the two forward speeds and pedal for reverse*

*Handbrake, but no gear lever*

*Front axle—no front wheel brakes*

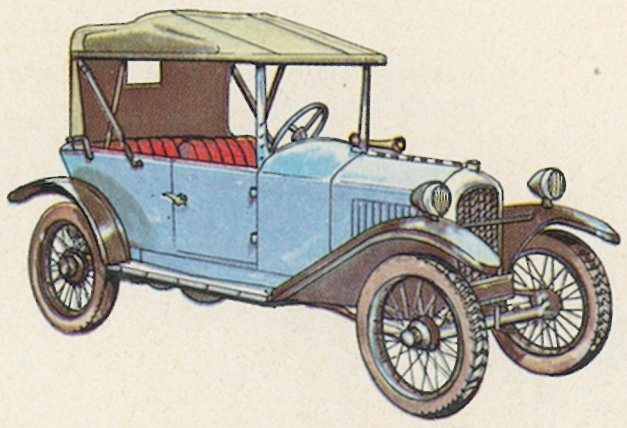
# **The motoring craze** in the 1920s

In the very early days motorists got their petrol from chemists. As more and more cars were used, the sale of petrol became the job of the local ironmonger. He sold the petrol in 2 gallon cans. Motorists who ran out of petrol at night were stranded until the morning. The first roadside petrol pumps began to appear in the early twenties.



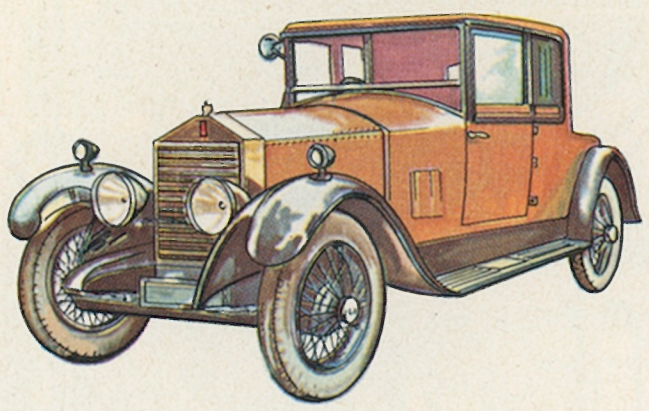

*Morris at early petrol pump*

Some of the light, cheap cars made in France (right), could travel more than 40 miles on one gallon of petrol, but they could not go very fast. There are no brakes on the front wheels. Cars with brakes on all four wheels are much safer but were not used on many cars until 1925. By 1920, most cars had electric lamps worked from a battery. Almost all the cars were open with hoods and were called tourers. They also had side screens that fitted into the tops of the doors and kept out most of the wind and rain.



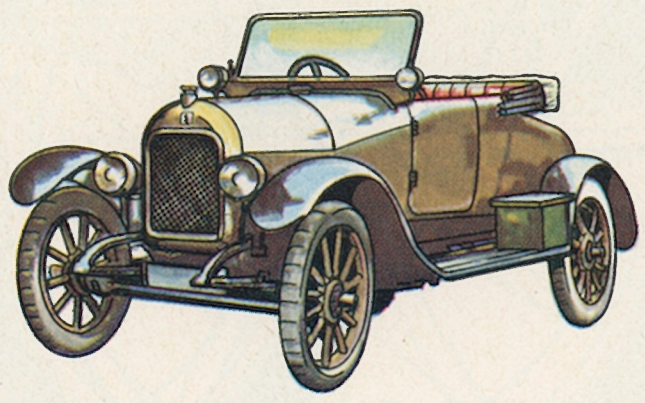
*Peugeot Quadrilette 1920*

The *Rolls-Royce* (right) was one of the best and most expensive cars in the world. They are still made today, but they look much more modern. They had large engines and were very powerful. People who had enough money to buy them did not worry about how much petrol they used. They wanted comfort, power and silence, and they did not mind how much they paid. *Rolls-Royce* cars were so quiet that one model was called the *Silver Ghost*.



*Rolls-Royce coupé 1927*

*Bean* cars (right) were made in Tipton, Dudley. In the twenties they became a very popular make. They were strong and reliable but heavy. Unlike the *Rolls-Royce* they were not made for the very rich. There were so many different carmakers in the twenties that it was not possible for them all to compete with those using mass production methods. *Bean* was one of the casualties.



*Bean 1920*

**American exports**

The First World War interrupted car production in Europe for three years from 1915 to 1918. As soon as the war was over more cars were wanted than ever before. Some people still wanted expensive luxury models, but thousands of cheap economy cars were needed too. Henry Ford had already discovered this new market with his cheap, fast-selling *Model 'T' Ford*. In fact, cars had to be imported from America into Europe. America thus became the first big car exporting country in the world.

**Mass production in Europe**

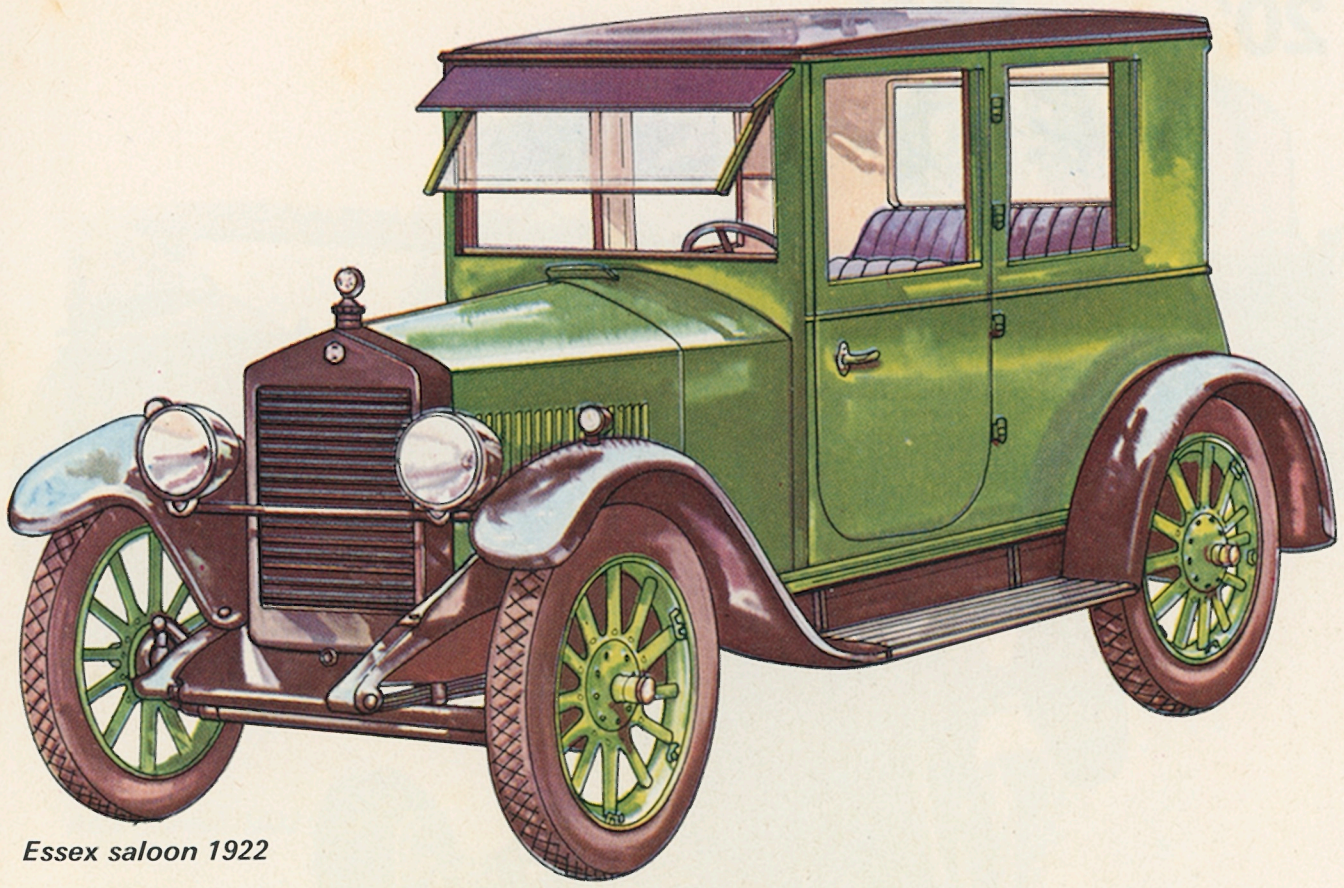
Imported cars solved the problem in Britain for a while, but it was obviously cheaper to manufacture the cars in the country where they were to be sold. Although the war had put a temporary stop to cars, it was to lead to a revolution in car production. During the war factory owners and engineers had to find ways of mass producing arms. After the war, some of the factories started to make cars again. The engineers adapted their ideas for fast production, and cars went into mass production.

Both Austin and Morris produced successful cars by these methods in the twenties. The secret of Austin's success was the small *Austin Seven*. In France, Italy, and Germany too, the trend was to producing cars cheap enough for the 'ordinary' people.

Of course, not all cars were mass produced. Many were still made by hand in small factories. In Europe there were many different makes of car—like the luxurious *Hispano-Suiza* and *Isotta-Fraschini*. There famous names were to disappear as mass production increased.

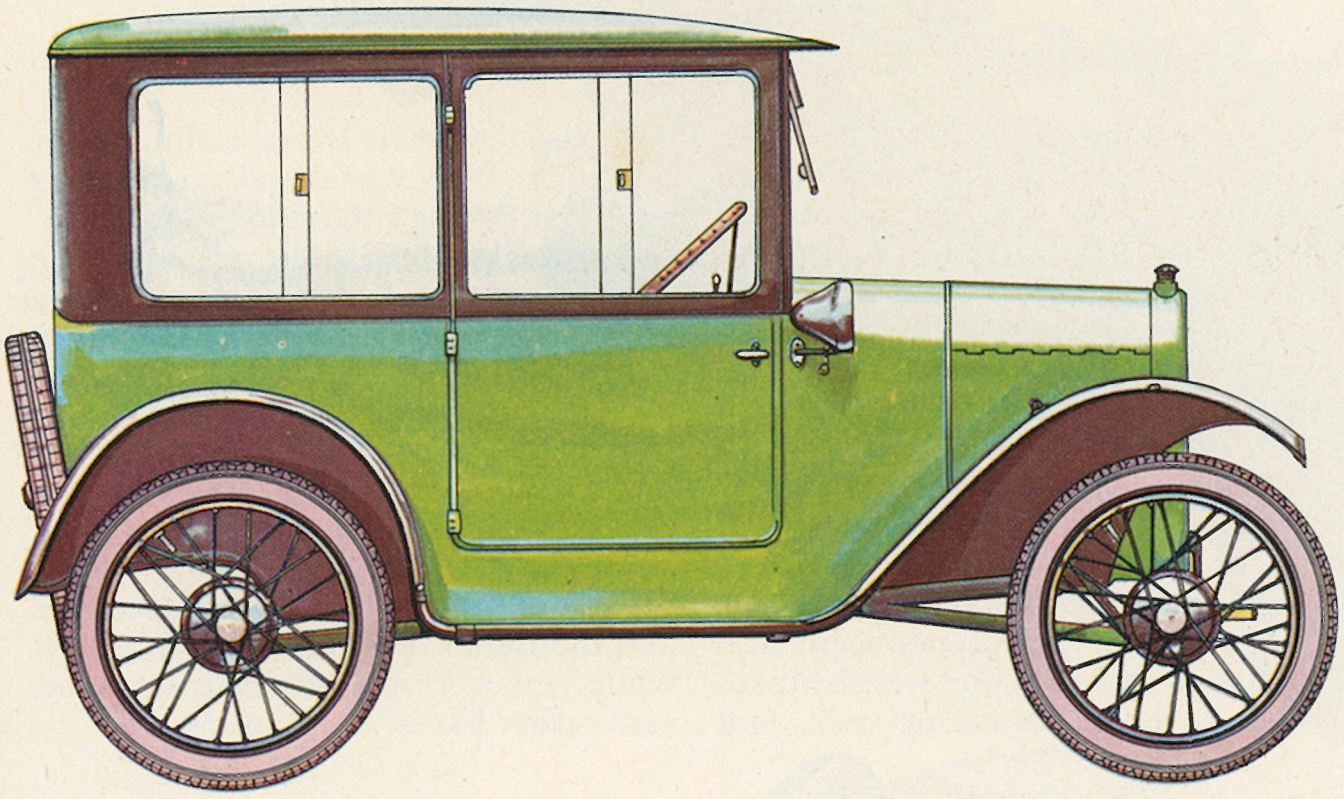
Car buyers wanted cars that were cheap to run as well as buy. This meant that the cars should not use much petrol. In America, petrol consumption has never been a problem, because petrol is cheap. In Europe, oil has to be imported so petrol is expensive. Most small cars have a lower petrol consumption than big ones, so they became very popular in Europe.

The car producing countries of the world made $3\frac{1}{2}$ million cars in 1924. By 1929 they were making over 5 million each year. Most of them were cheap cars for ordinary families.



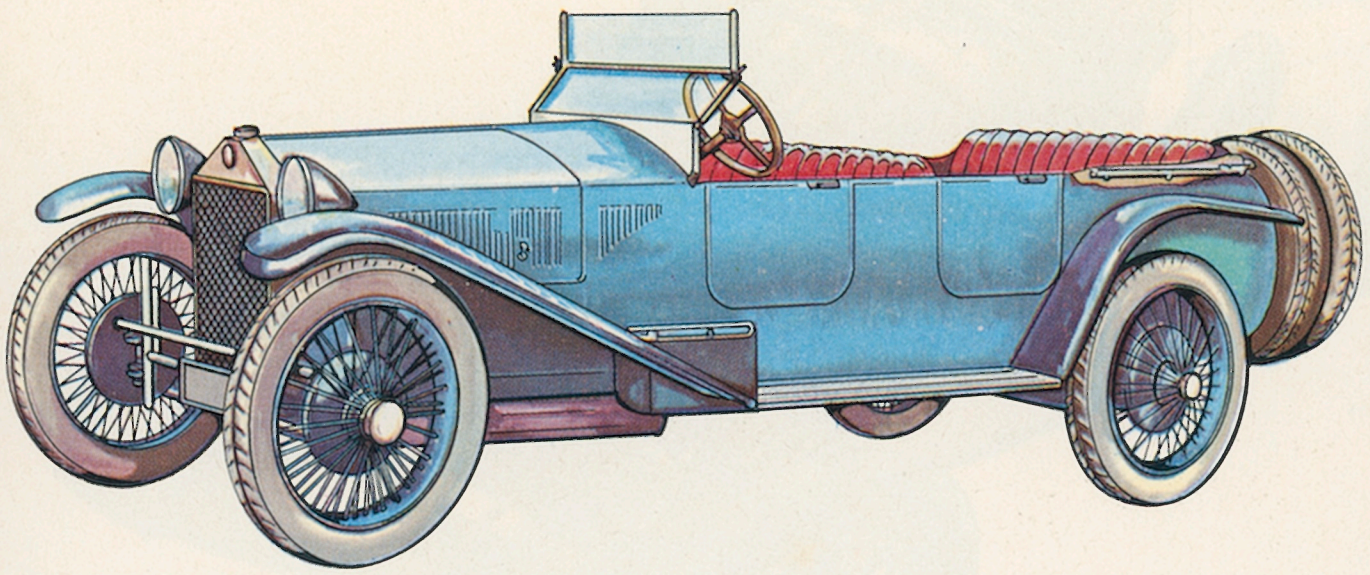
*Essex saloon 1922*

The *Essex* (left) was the first cheap saloon car to be made in America. The passengers all sat under cover and were much more comfortable than they would be in a tourer on a wet, windy day. If they wanted more fresh air on a hot day, they could open the windscreen.
Saloon bodies like this became more and more popular, and by about 1928 there were more saloons than tourers built each year. The body of this *Essex* was made from steel, but some cars had bodies made from stiff cloth called fabric. Very few European cars had wooden wheels after 1922, although they were used in America into the 1930s.



*Austin 7 1928*

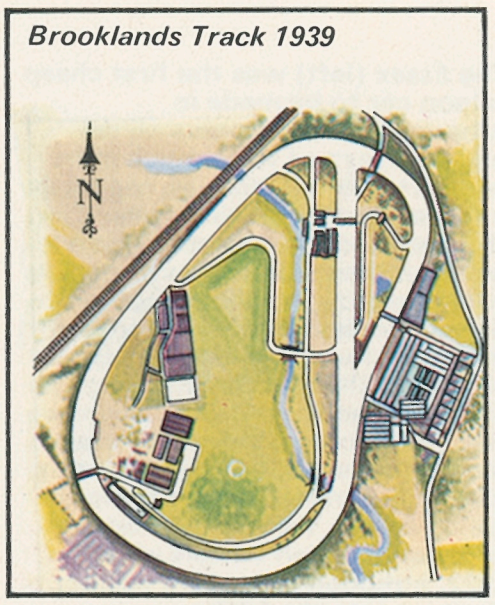
Herbert Austin, a British car manufacturer who became a lord, made the first successful baby car in Europe in 1922. All the mechanical parts were made in his own factory. These cheap little cars made motoring possible for everybody. The 1928 saloon model (left) cost £150 and it did not cost much more than $\frac{1}{2}$p a mile to run. Although it looks very small, there was enough room for three children in the back.



*Lancia Lambda 1925*

The *Lancia Lambda* (left) could go at more than 70mph. It was an expensive Italian car. Most 1920s cars still had running boards which acted as steps for getting in and out. Wheels were large and the seats were quite high up in the bodies. The *Lambda* pioneered unit body chassis construction. Streamlining was not yet an acceptable feature of cars. The radiators and the lights, for instance, were not fitted into the shape of the body, and the front and rear wings were separate from the rest of the body. Spare wheels were carried outside, either at the back or fixed on to the running board.

# Racing in the 20's and 30's

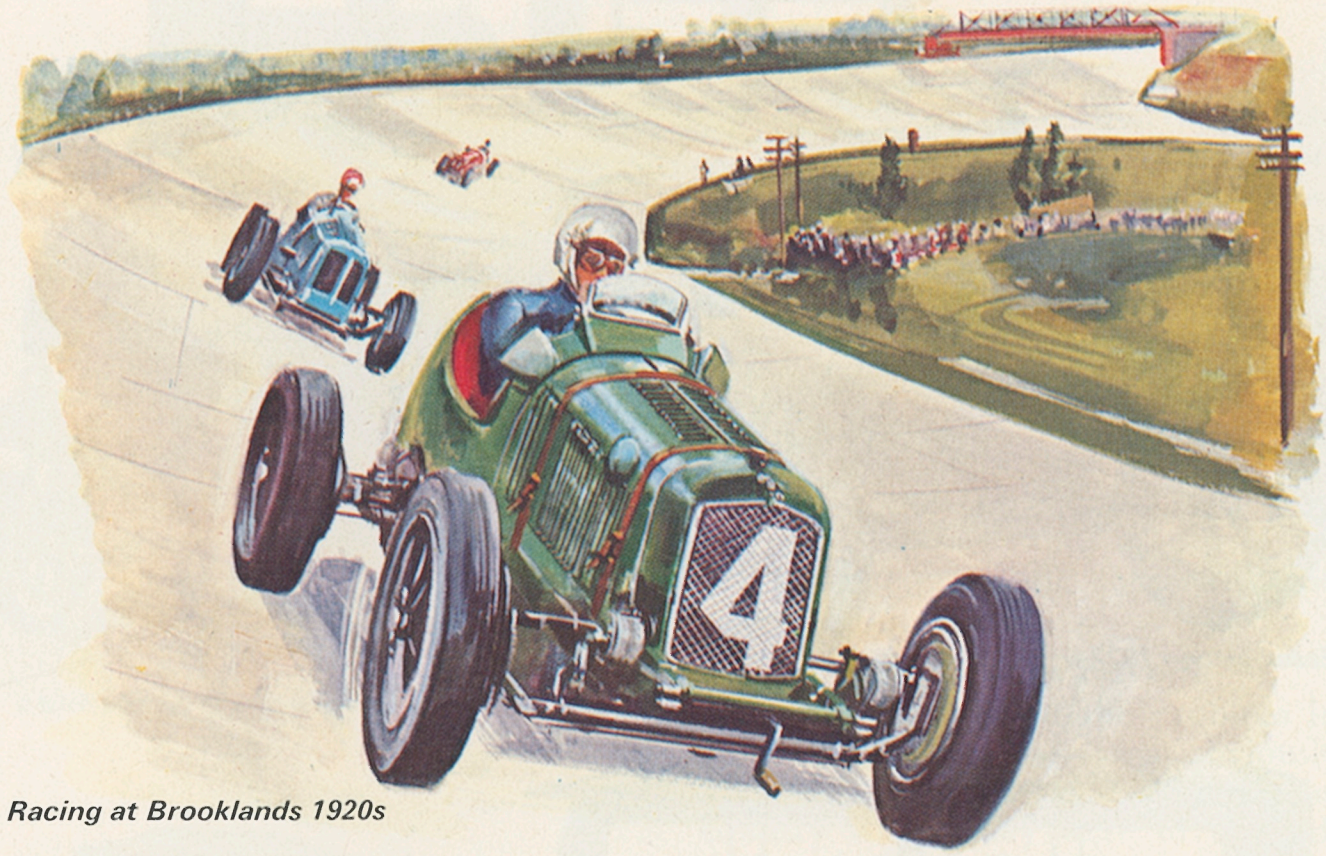



*Brooklands Track 1939*

Brooklands Course in Surrey, England (above) was the first circuit in the world to be built specially for car racing, as long ago as 1907. Similar ones were made in America, France and Italy. These large circuits were made of concrete, and banked curves were used on the corners. Such circuits are ideal for testing cars as well as for racing.
Maximum speeds round the 2·8-mile Brooklands Course increased steadily from 1922 to 1935.

1922—123mph
1924—128mph
1925—129mph
1928—131mph
1929—134mph
1930—135mph
1932—137mph
1934—140mph
1935—143mph

In 1935, John Cobb drove a *Napier-Railton* car at an average speed of nearly 152mph over half a mile. This was the highest speed ever recorded at Brooklands.




*Racing at Brooklands 1920s*

## The testing sport

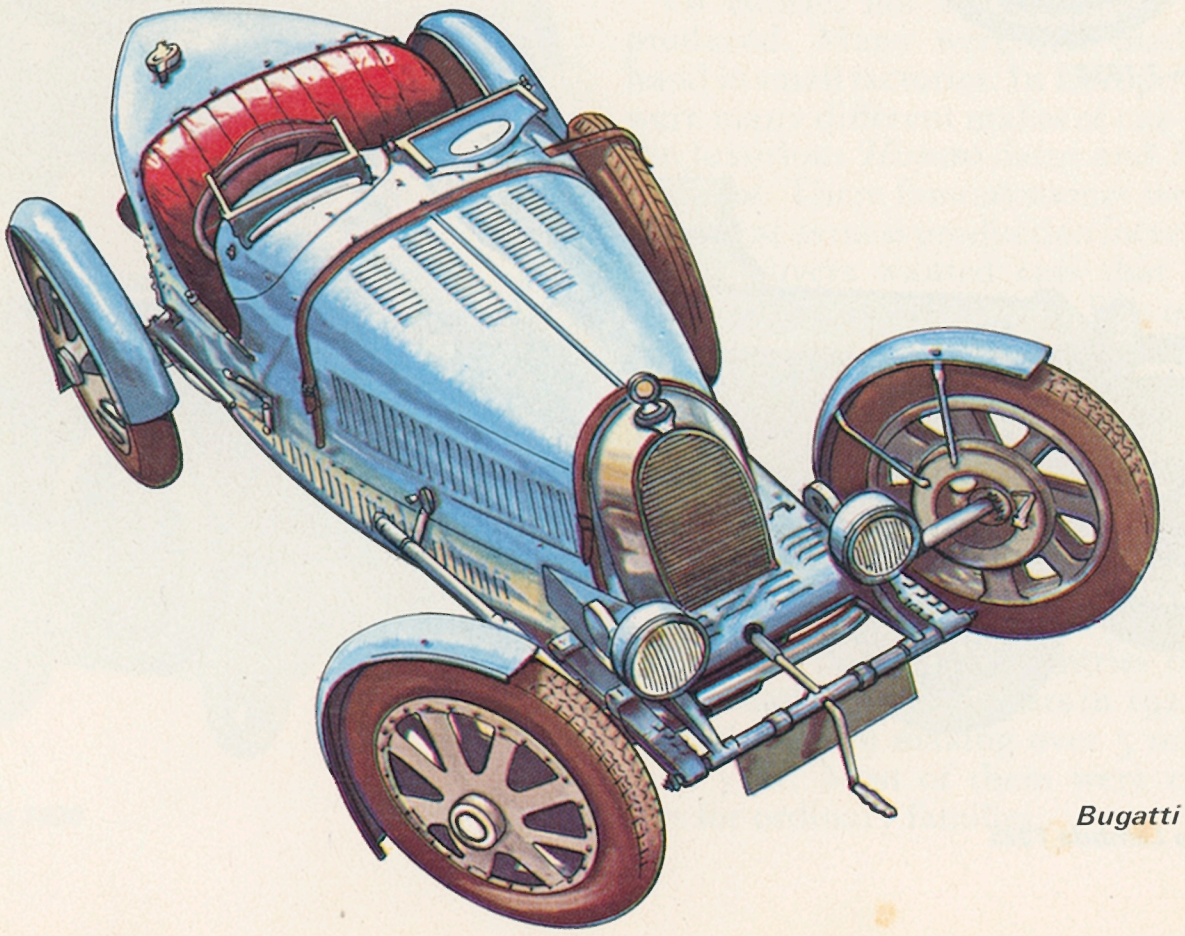
From the very early days of motoring racing has been very important for two reasons. As a sport, it has tested the skill and daring of the drivers, and given enjoyment to thousands of spectators. Apart from that, racing has tested the cars themselves. The high speeds meant that the cars and engines had to work much harder than if they had been used for normal motoring. If parts were weak or badly designed, motor racing soon found them out.

Experimental prototypes were also tried out in racing. Four-wheel brakes were first tested on racing cars, and within a few years every ordinary car had them. New wheel and tyre designs were put through the same tough tests. Race tracks were built all over the world from about 1910, because of the high rate of bad crashes in the early road races.

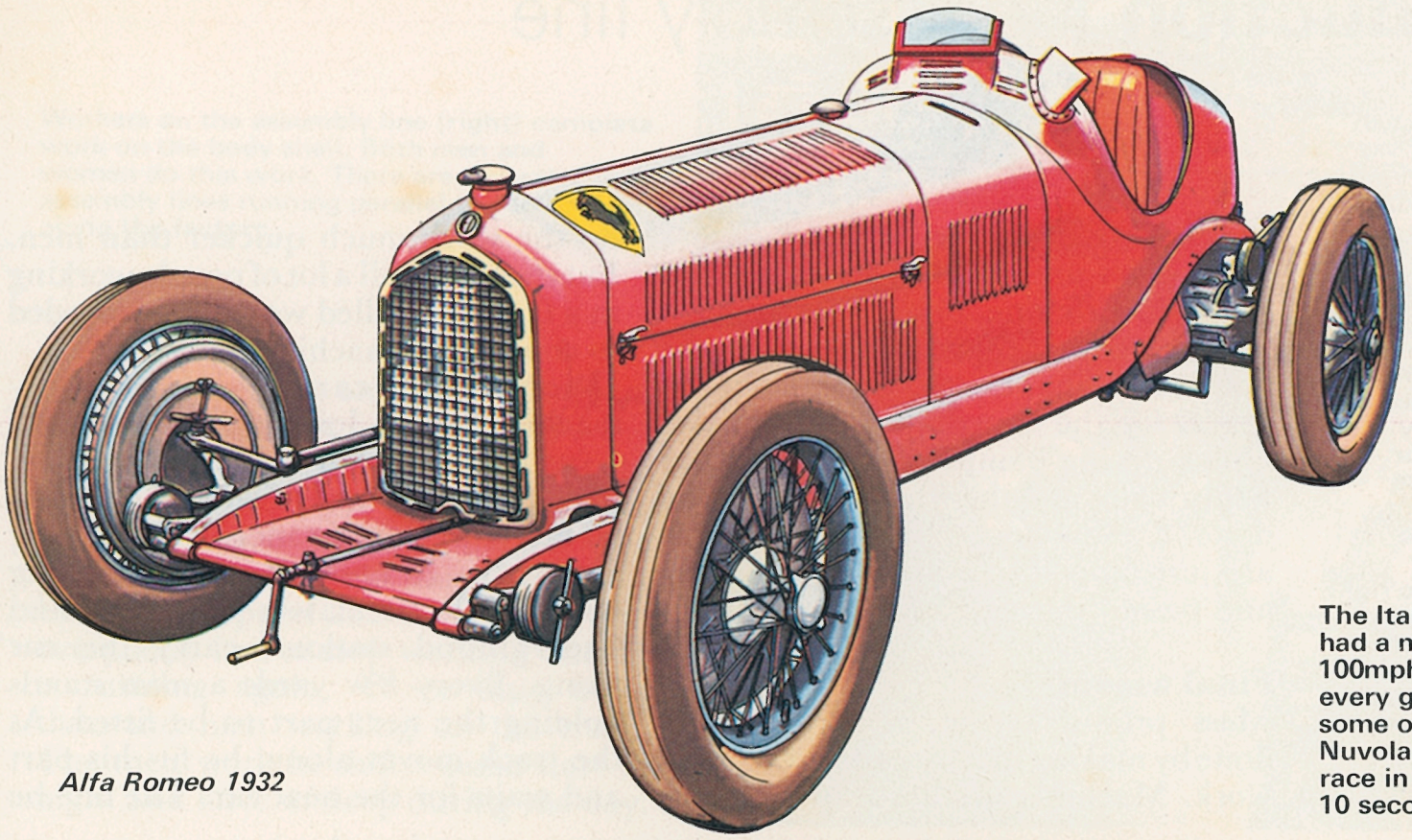
Once cars became safer, road racing started again on the Continent, but over sections that were closed to the public. Now, cars are made specifically for racing and for breaking speed records. Race tracks remained popular and thousands of people went to watch while bets were placed on drivers and cars rather like at horse races.

The 1924 Type 35 *Bugatti* (right), with an 8-cylinder engine, was the most successful racing car of all time. Yet some of the *Bugatti* models could be used on the roads as ordinary cars as, unlike most other racing cars, they could be fitted with lights, wings and a hood.

Ettore Bugatti, who finished his first car in 1909, was a brilliant designer. Every part of any car he sold was made with the same precision as the smallest part of a watch. There is still a number of his cars left today. Some are in museums, but some people still race them in special events for vintage cars.



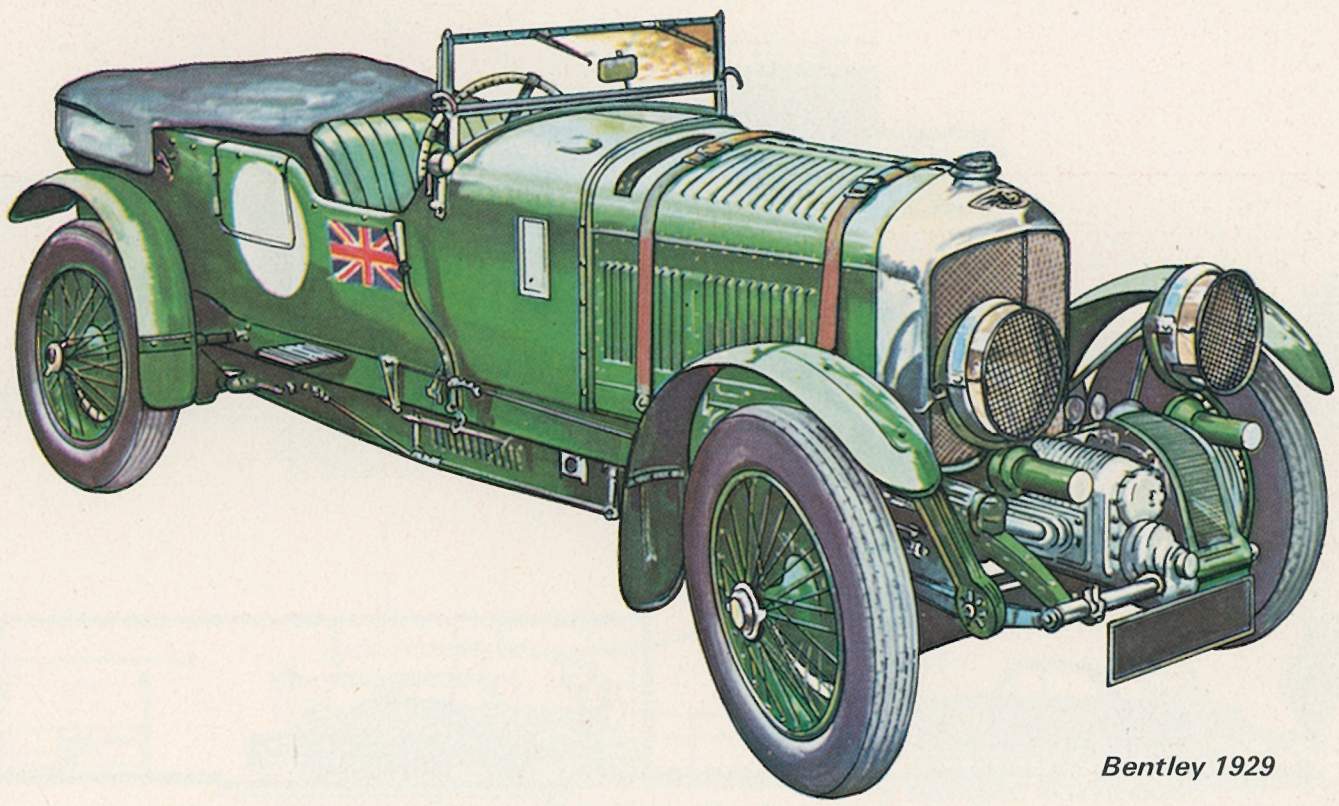
*Bugatti 1924*



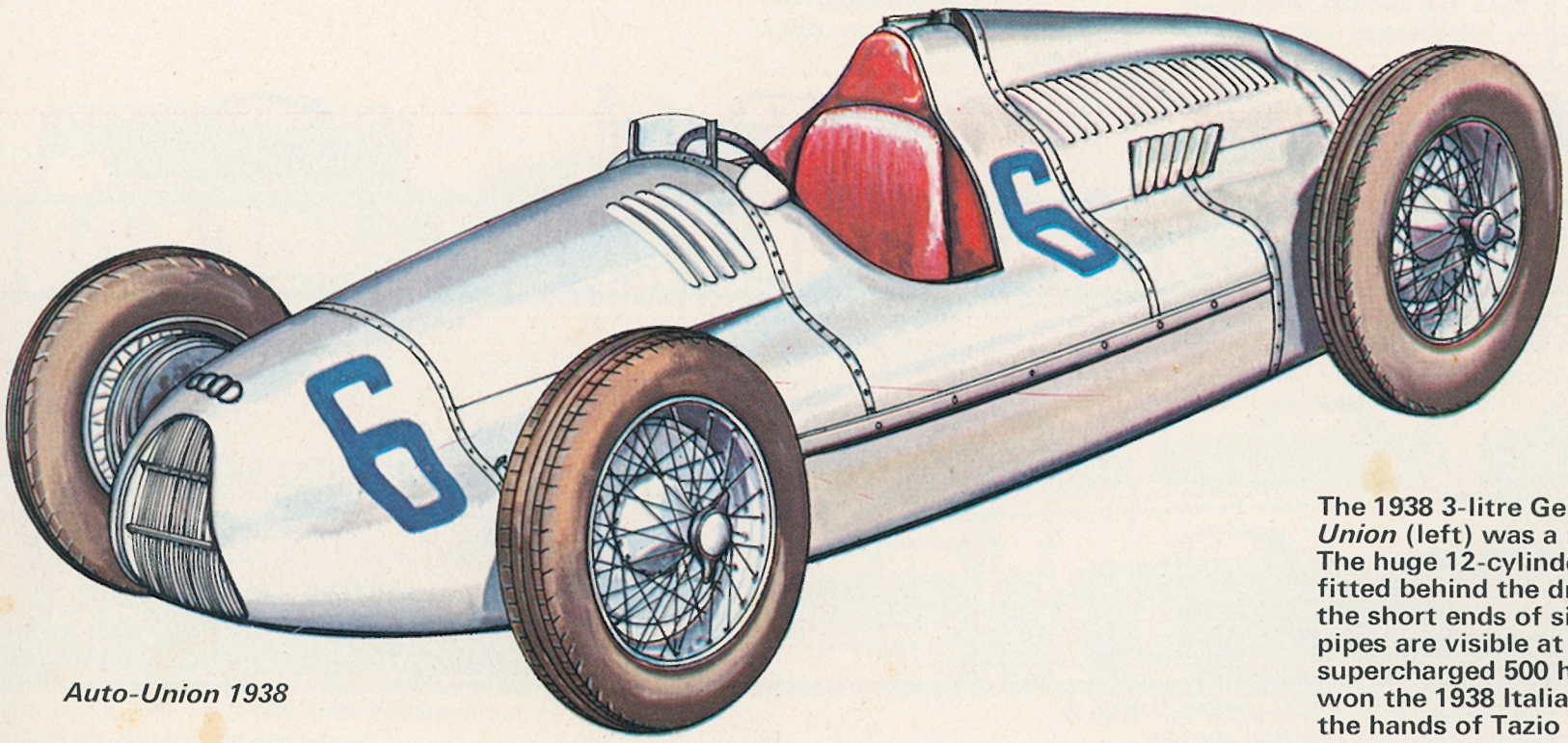
*Alfa Romeo 1932*

The Italian 1932 *Alfa Romeo* (left) had a maximum speed of over 100mph. *Alfa Romeo* won almost every great international race, some of them more than once. Nuvolari won the Le Mans 24-hour race in France in 1933 by 10 seconds in a sports *Alfa Romeo.*

This British car is a $4\frac{1}{2}$-litre *Bentley* (right). In Europe, engine capacity is measured in cubic centimetres and is calculated on the area swept by the pistons. In the U.S. the size is measured in cubic inches.



*Bentley 1929*




*Auto-Union 1938*

The 1938 3-litre German *Auto-Union* (left) was a real racing car. The huge 12-cylinder engine was fitted behind the driver's seat—the short ends of six of the exhaust pipes are visible at the side. This supercharged 500 horse-power car won the 1938 Italian Grand Prix in the hands of Tazio Nuvolari.

# **Mass production** the assembly line

This diagram below is of a typical modern assembly line. Each firm's line differs in small ways. In all firms a lot of the parts are made in other factories. Sometimes, as with tyres, they are made by another firm altogether. (For example, Ford in America are producing a new car, the Pinto, using engines built in Britain.) The diagram represents a continuous flow from left to right. The process starts in the Press shop. The big machines are very noisy. They press the sheet steel into shape to make boots, bonnets, wings, and other pieces for the car bodies. The biggest presses have a pressure of 2,000 tons.

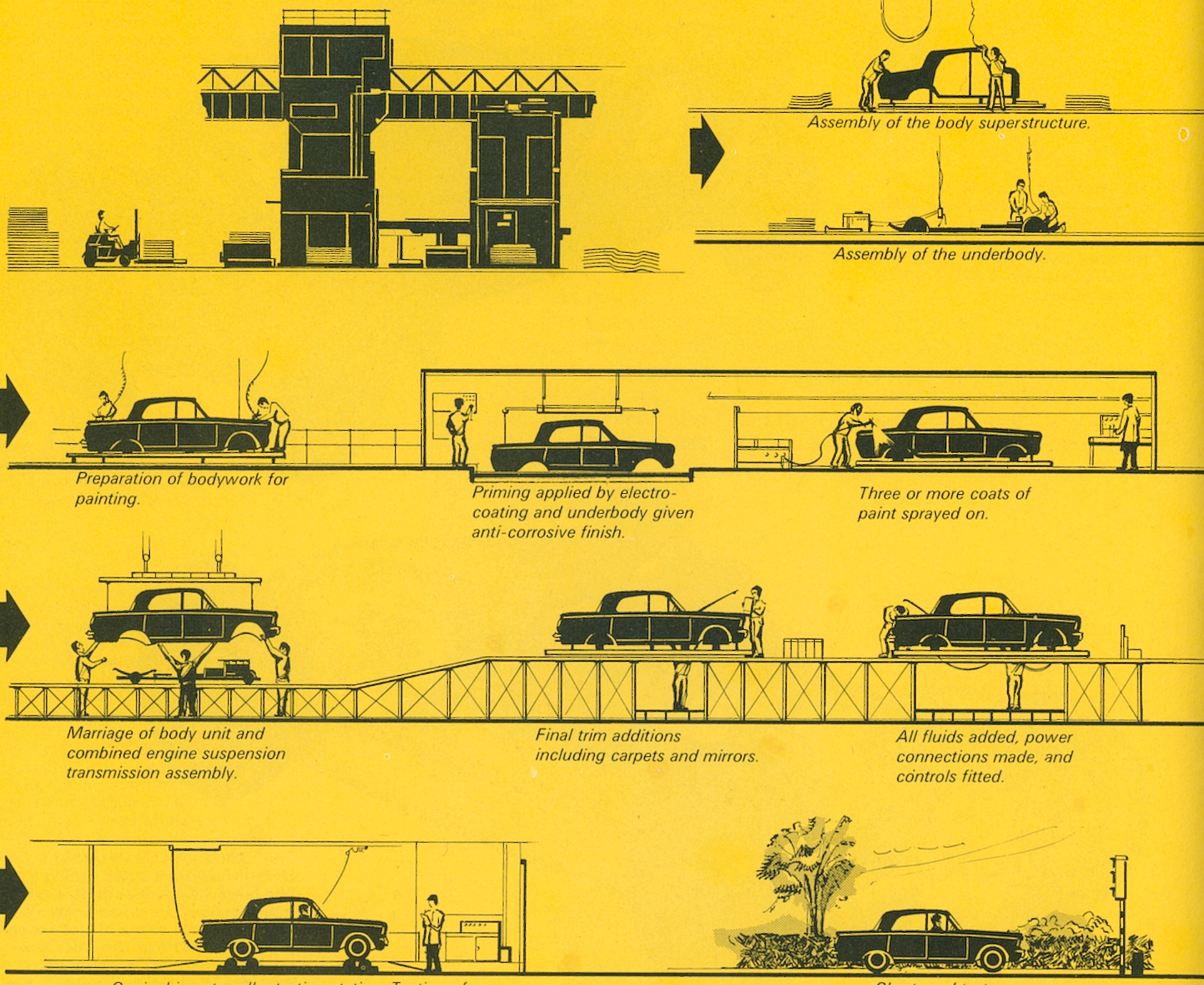
**Machine-built cars**

Car bodies are pressed out of a sheet of steel with one blow from a huge machine called a press. This gives the body all its shapes, and cuts out all the spaces for the doors and the windows. Quick-drying paint is sprayed on from a spray-gun and the whole thing can be done in a few hours. Some small parts are just dipped in a large tub of paint and passed through a hot oven to dry.

**Final assembly**

Mass production of modern cars is done by making machines do most of the work. Machines are accurate and can do the work much quicker than men. But there are still a lot of people working in a factory. Skilled workers are needed to control the machines.

Some jobs cannot be done by machines at all. Joining all the parts of a car together is called final assembly. This is done by men. The finished parts all arrive at the entrance of a very long workshop. A number of flat moving tracks, like escalators in shops and underground stations, carry the car along. Every few yards a man stands holding the next part to be fitted. As the track moves along, he fits his part and waits for the next car. The one he



*Assembly of the body superstructure.*

*Assembly of the underbody.*

*Preparation of bodywork for painting.*

*Priming applied by electro-coating and underbody given anti-corrosive finish.*

*Three or more coats of paint sprayed on.*

*Marriage of body unit and combined engine suspension transmission assembly.*

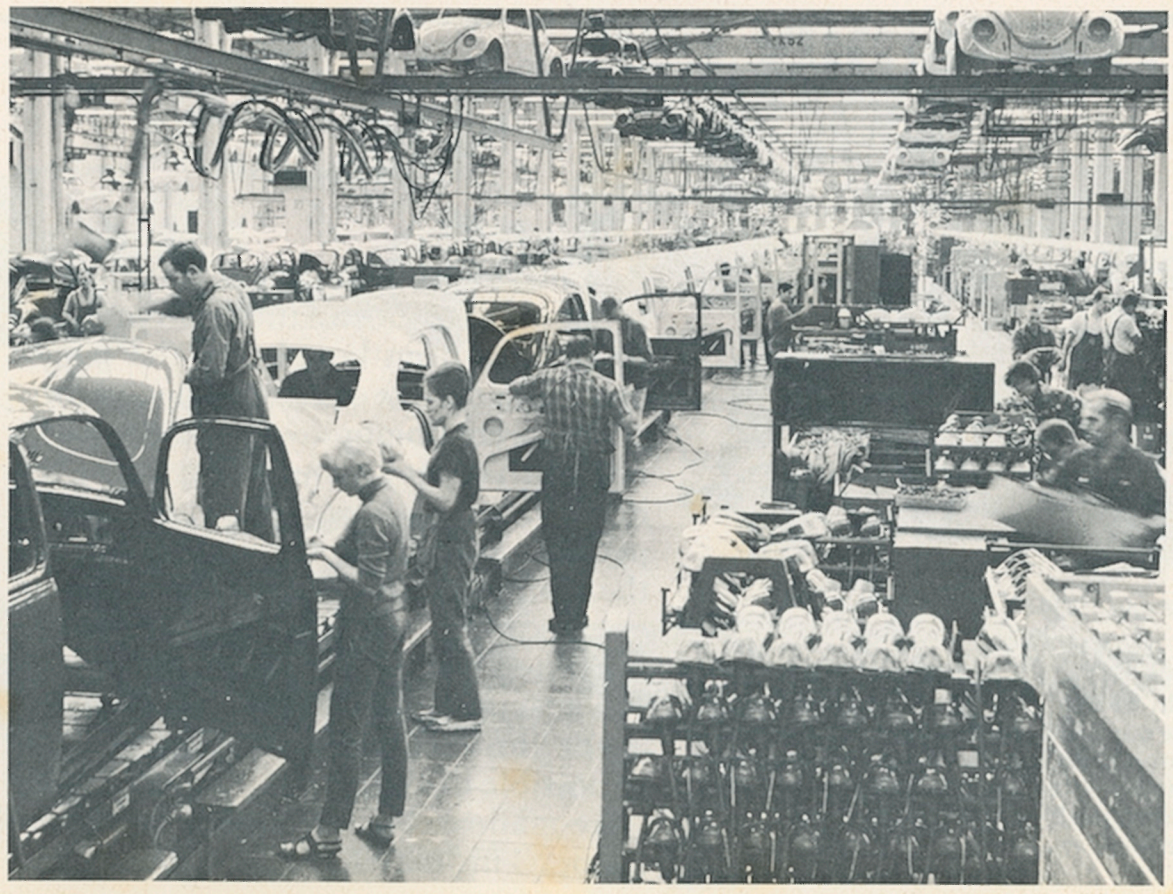
*Final trim additions including carpets and mirrors.*

*All fluids added, power connections made, and controls fitted.*

*Car is driven to roller testing station. Testing of mechanical parts and electrical circuits.*

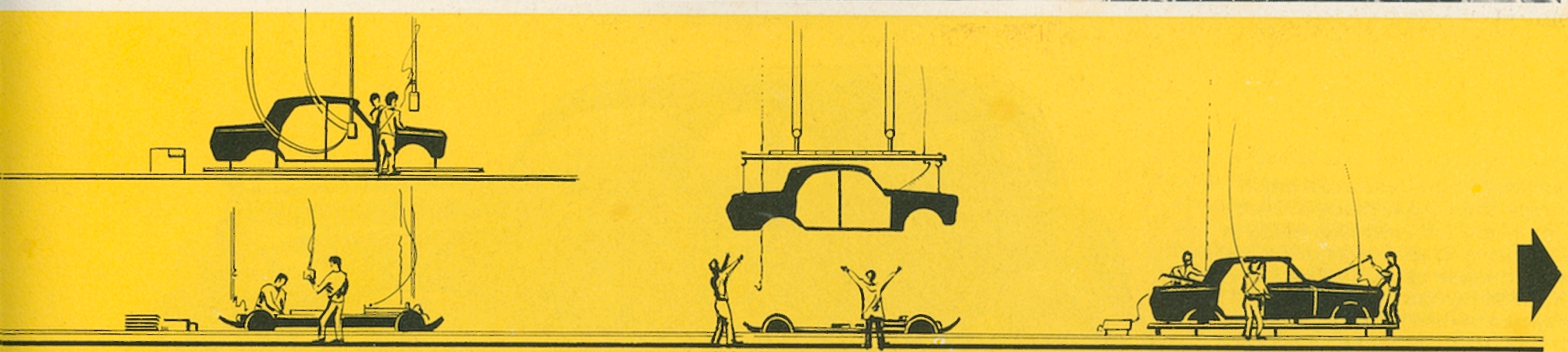
*Short road test.*

**Workers on the assembly line (right) complete work on the body shell. Both men and women do this work. There are several assembly lines running parallel to each other along the factory.**



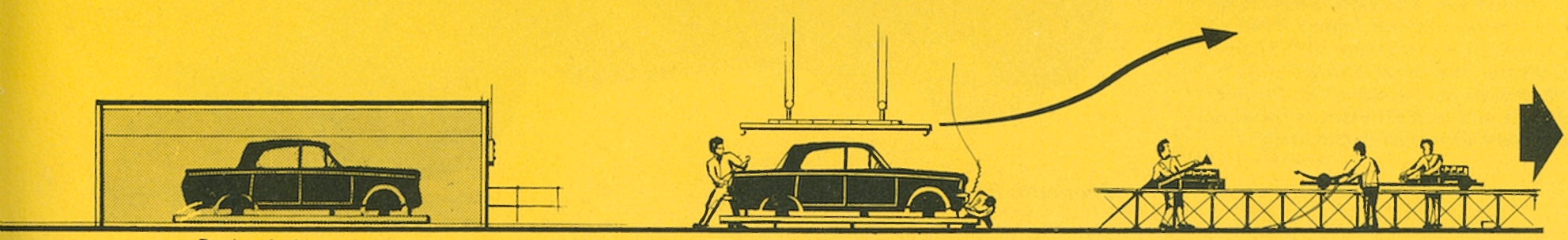
has just done goes on to the next man, who fits a different part.

Everyone must be accurate and quick. There cannot be any mistakes, and if a part is missed it may not be possible to fit the next part. The track has to be stopped and that means that everybody has to stop working until it is running again. There may be a thousand men working on the track. The men work in shifts: some start at night and have to sleep during the day.



*Welding together of superstructure and underbody.*

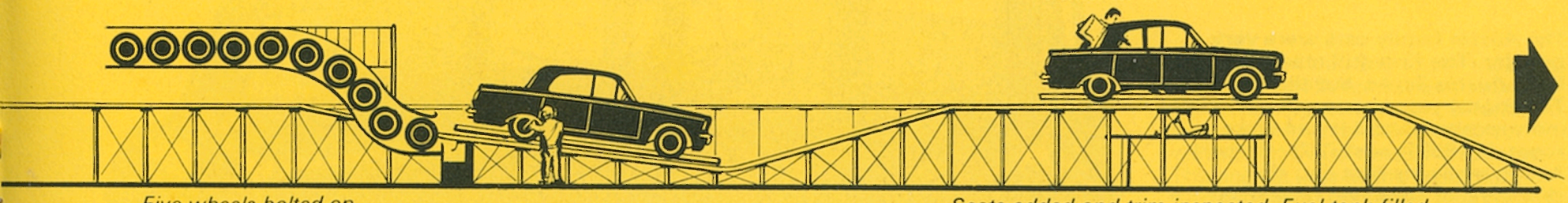
*Addition of doors, bonnet and boot covers.*



*Drying in heated ovens.*

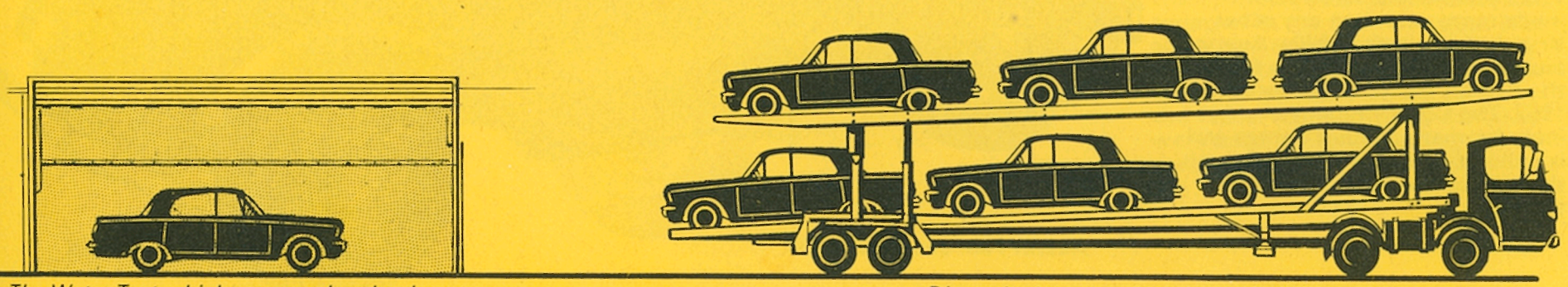
*Trim shop where hundreds of parts added. These include grill, electrical wiring, lights, windscreen, windows.*

*Casting of engine block and cylinder head. Assembly and checking of engine, engine parts, gearbox. Marriage of gearbox and engine. Bolting together of all the engine, transmission, and suspension elements.*



*Five wheels bolted on.*

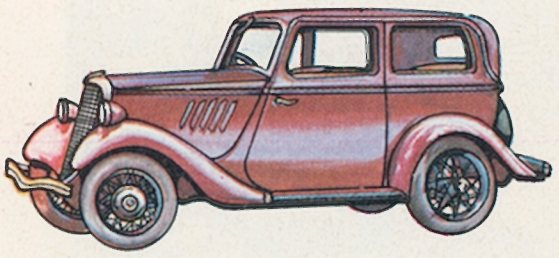
*Seats added and trim inspected. Fuel tank filled.*



*The Water Test—high pressure bombardment to check for leaks. Final inspection.*

*Dispatched to trade lines to await delivery.*

# The family car



*Ford 1939*

In 1935 Ford in Britain brought out a car that the average family could afford. With its 8hp engine it could average 40mpg and reach 60mph. It was also cheap to maintain.

**Age of the 'tin box'**

By about 1930 most of the small car firms had either been bought by the bigger ones or had gone out of business. Many people were unemployed and there was not much money about. Most countries, in fact, were short of money in this period—known as the depression, or the slump. People naturally cut down on luxuries, so manufacturers concentrated on producing cheap cars.

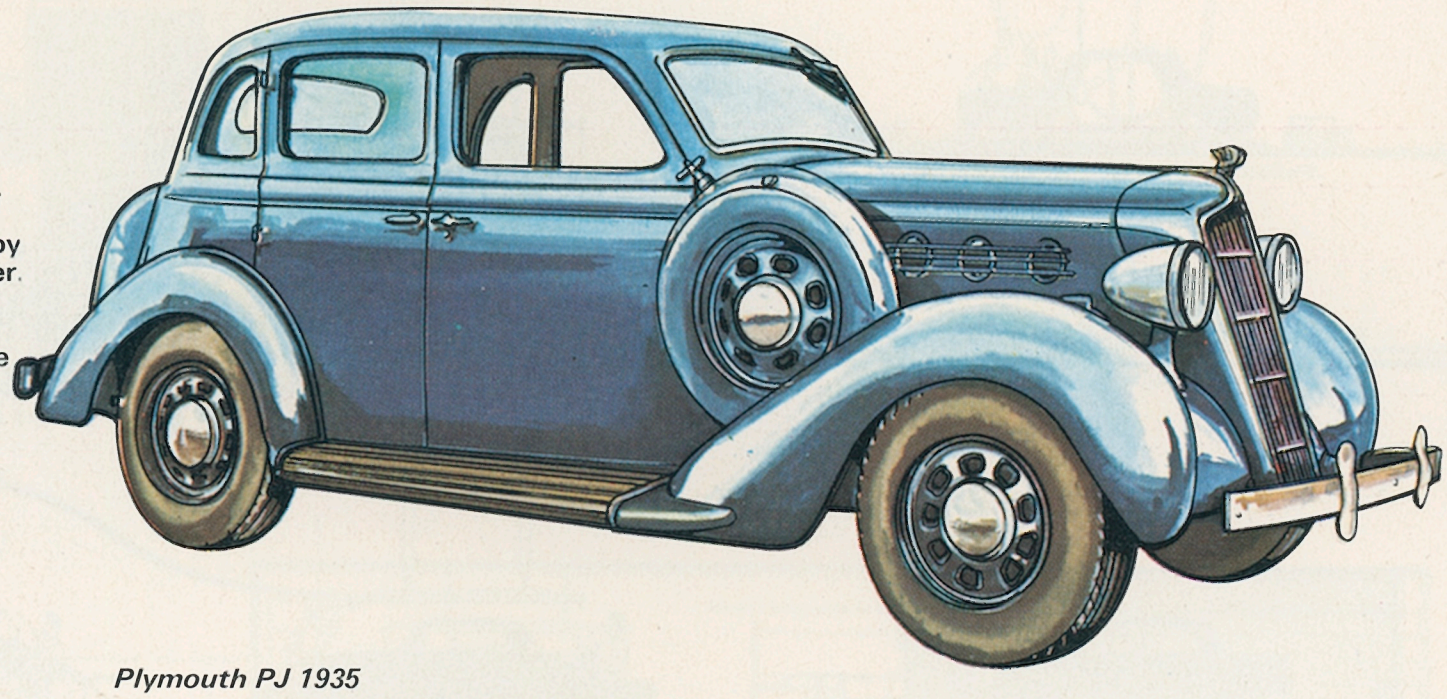
The outside measurements of the cars in the 'tin box' age were kept as small as possible to save metal, and the bodies were made as big as possible within the frame. This may have been cheap, but it did not provide much comfort. The rear passengers, for instance, often had to sit right over the back wheels.

**Evolution of the modern car**

Advances in design were generally restricted to technical details, and little attention was paid to improving the looks of cars. Bodies became lower and new types of suspension were devised. Both features aided road-holding and facilitated a smoother ride. Streamlining and higher gear ratios made more speed possible. By 1939 the essentials of today's family saloon were in evidence.

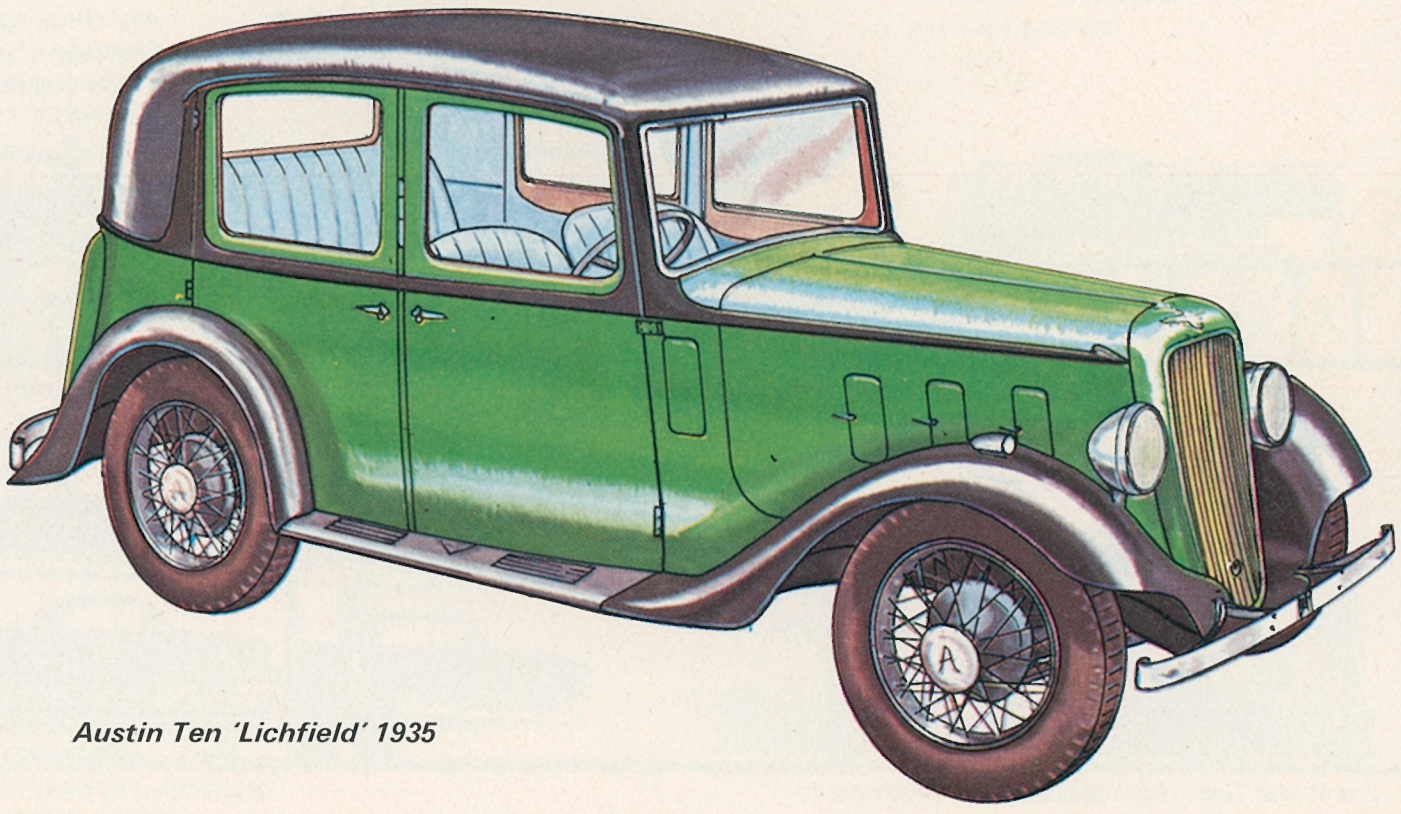
American cars were still much larger than those made in Europe. The first *Plymouth* was made in Detroit in 1928. It was produced by an American called Walter Chrysler. By 1934 he had made a million *Plymouth* cars. The 1935 model (right) had the spare wheel on the side of the bonnet, while 1936 models had the spare at the rear.

From 1924, Chrysler also made cars under his own name. The Chrysler Corporation still makes *Chrysler, Imperial, Dodge* and *Plymouth* cars today. The French Simca and British Rootes models are now Chrysler controlled.



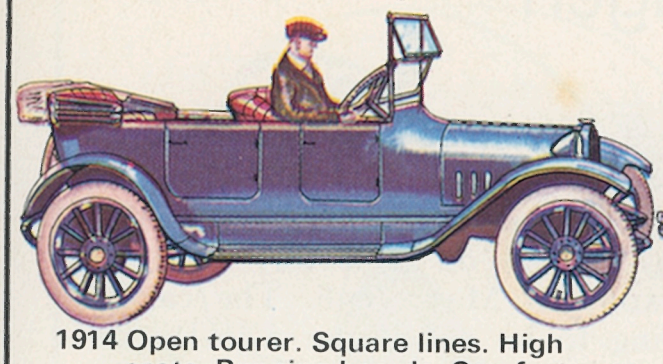
*Plymouth PJ 1935*

The *Austin* family cars were very popular. The firm still made the little *Austin Seven,* but the *Austin Ten* (right) was not very much more expensive and it had more room. In 1935 it cost £175. Herbert Austin made his first car, the *Wolseley,* in 1898, and he started his own factory in Birmingham in 1906. Austin, Morris and Ford made more cars than any other British firms in the 1930s. Austin and Morris were joined to form the British Motor Corporation in 1952. The Corporation now includes many famous names and is called British Leyland, although the old names are still used for the cars.

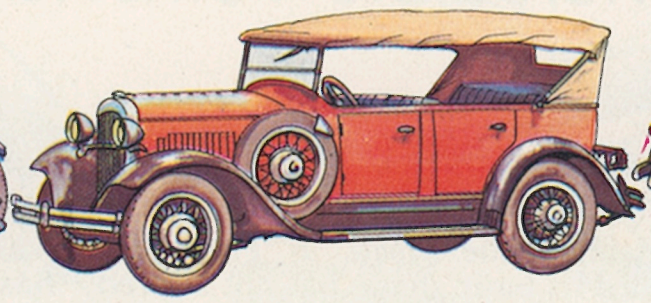


*Austin Ten 'Lichfield' 1935*

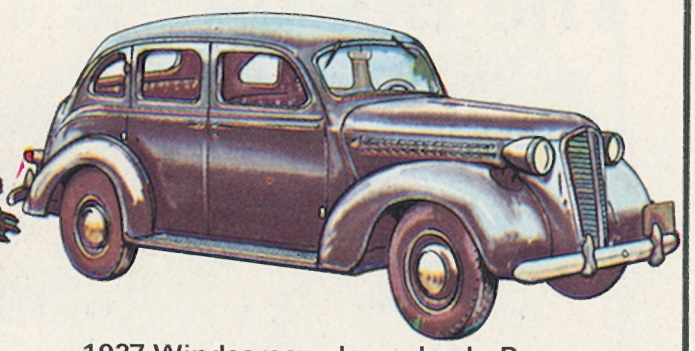
*The changing shape of Dodge Cars 1914-1974*



1914 Open tourer. Square lines. High seats. Running boards. Comfort not important.

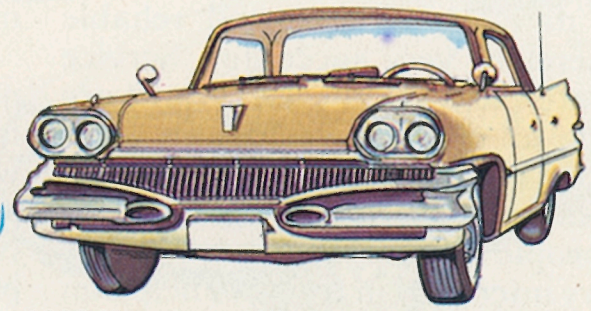


1927 Tourer. The body is still high and square.

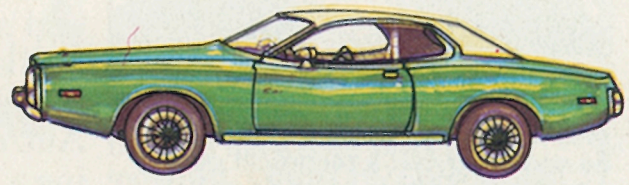


1937 Windscreen slopes back. Bumpers. Wings become part of the body. Body lower. Radiator shell and body curve.

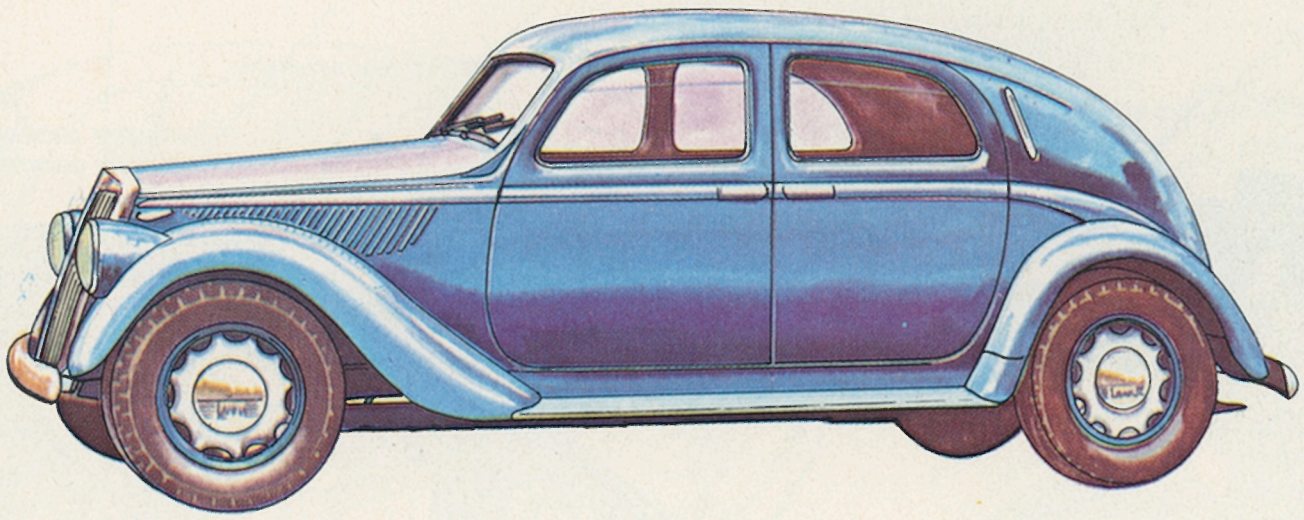
1950 Windscreen slopes back even further. The running boards almost gone. The radiator shell, wings and head-lamps, moulded more into the body.



1960 No wings. Windscreen is curved round. Bonnet and boot same size.

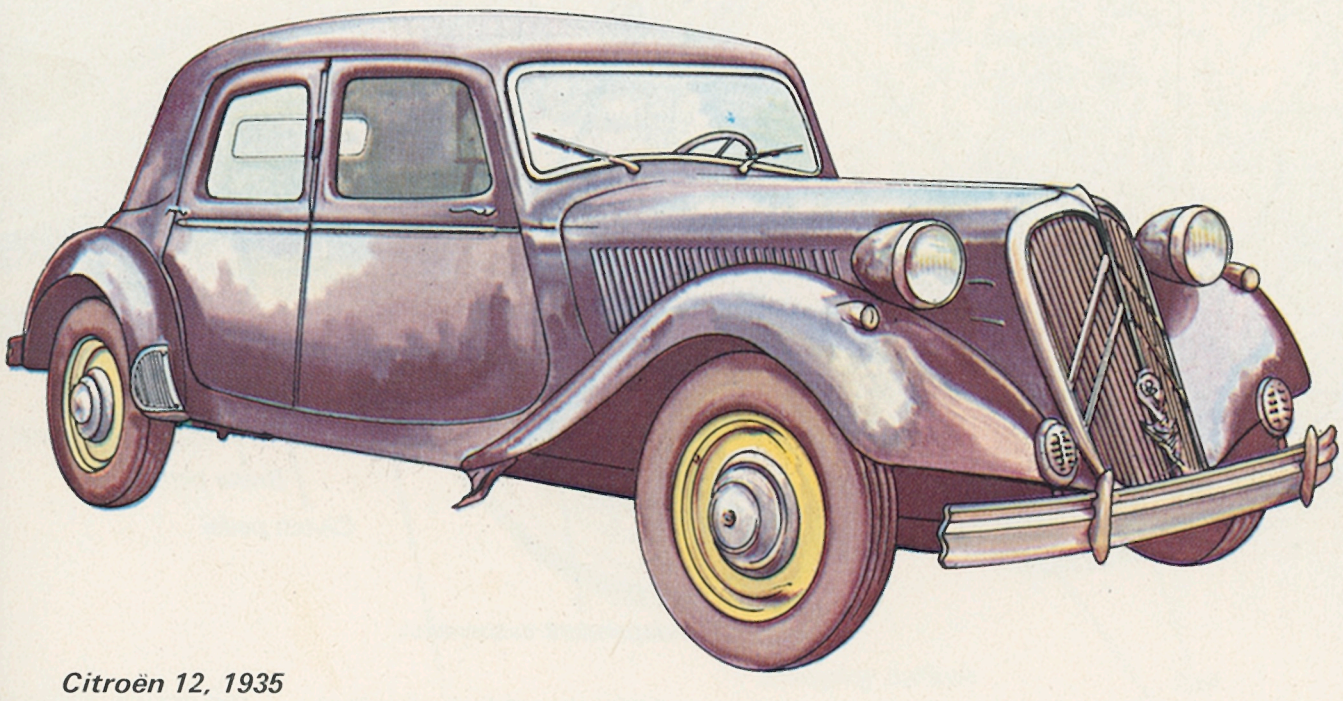


1974 The modern car. There is little difference between front and back.



*Lancia Aprilia 1939*

Italian *Lancia* cars have always been different from other makes, and the designs were often ahead of the times. The *Aprilia* model used independent suspension, where each wheel is sprung separately instead of the wheel springs being connected. Cars with independent suspension can be more comfortable to drive, and are much safer because they have better roadholding. The car was also very low and streamlined so that there was less effect from the wind. Much of the engine was made of aluminium, which is a very light metal. It had a top speed of 80mph and a low petrol consumption of 28mpg.



*Citroën 12, 1935*

The *Citroën* was one of the most popular French family cars from 1919. The Traction Avant, shown here, was introduced in 1934. It was ahead of its time in two ways. The engine was in the front and drove straight on to the front wheels. The body was built up from pressed steel sections welded together in the form of a box. The same idea is used today. This type of body construction was stronger than that on many of the cars of the 1930s. Many of these *Citroëns* were used in France during the war, and a few are still in use.

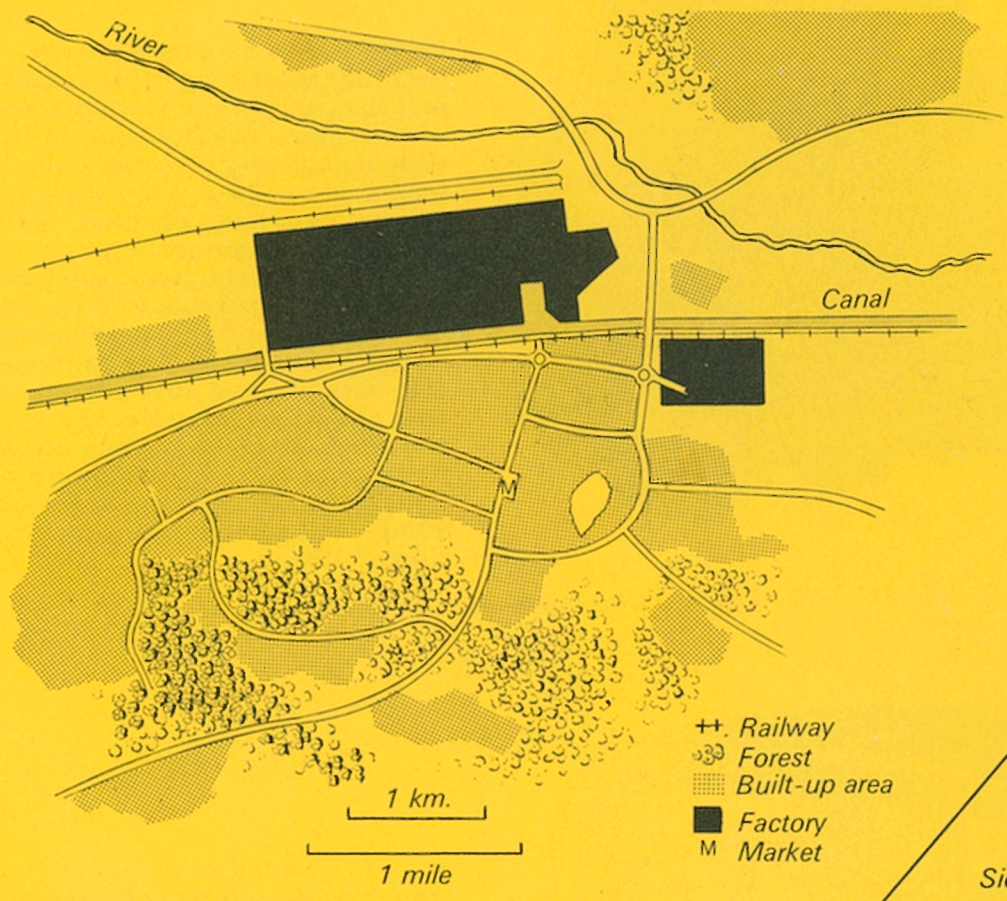
# **The Beetle** the incredible Volkswagen

Ferdinand Porsche was born in Austria, 1875. At 15 he was still only a tinsmith's apprentice but he soon showed a technical genius which earned him fame as a car designer. He shared Henry Ford's vision of a cheap car for the millions but could not convince the German manufacturers to sponsor him. Hitler was convinced, however, and with his backing Porsche went ahead.

The *Volkswagen* '*Beetle*' has been as successful as the *Model 'T' Ford*. Like the Ford its basic shape has not altered since it was first made, although all the working parts have been redesigned to improve the car. Although it looks out of date, it is cheap and reliable and therefore very successful. Service and spare parts for the *Volkswagen* are available all over the world.

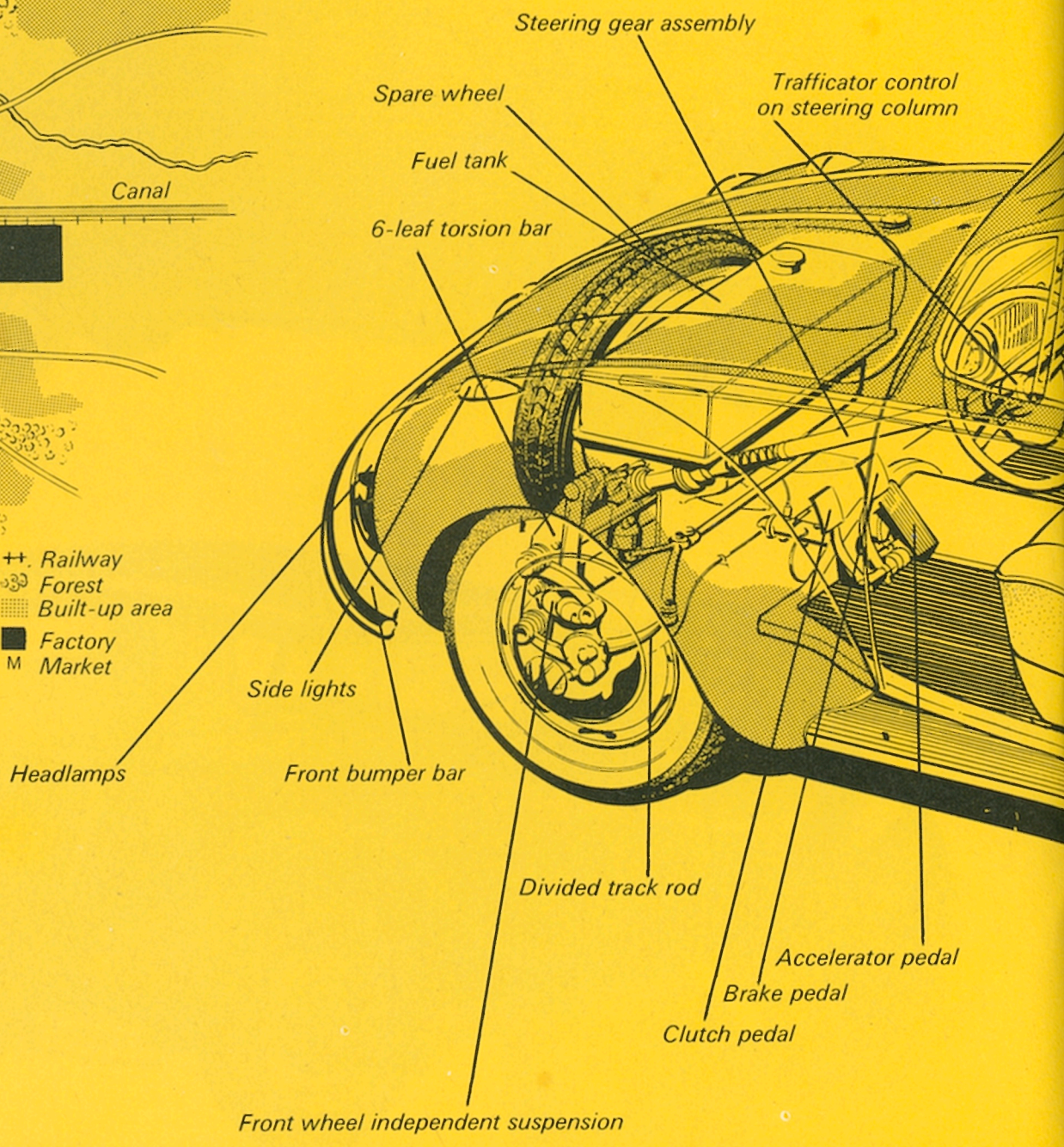
Ferdinand Porsche, a brilliant Austrian engineer, first thought of making a 'people's car' in the 1920s. Nobody was very interested in trying to help him at first. Three cars were made and tested in 1936. By 1938, Germans were offered the chance to start saving in advance for one of the new 'people's cars'. Thousands of them did so. Work was started on a factory in Lower Saxony in May, 1938. The car was going to be called the *KdF-Wagen*—the 'Strength-through-joy Car'. A year later, when only a few cars had been made, the war stopped production.

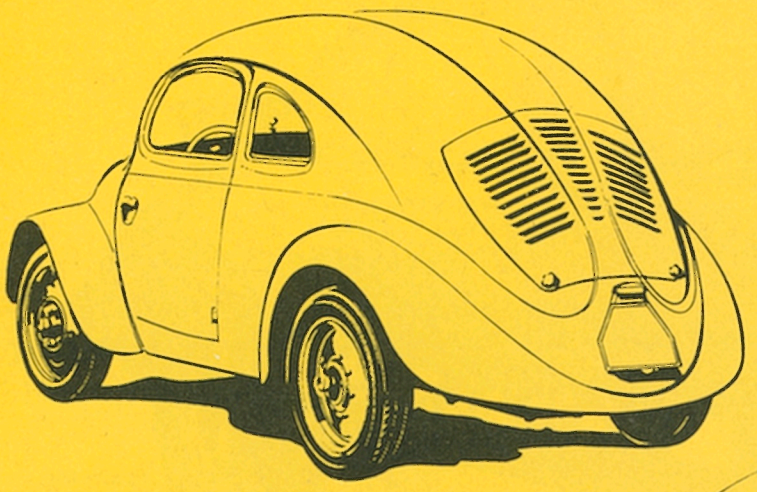
For the next four or five years the new factory made the *Kubelwagen* military jeeps and armaments. The factory was destroyed in the American air raids at the end of the war. Professor Heinz Nordhoff who took over the factory as a heap of rubble, built up a huge new factory which is now in its own town of Wolfsburg where 95,000 workers and their families live.




*Town plan of Wolfsburg.*

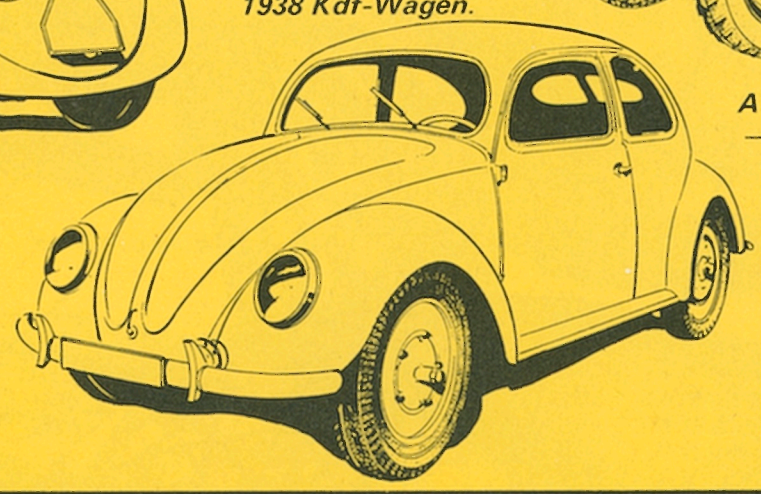
The town was founded in 1938 by the Nazis. Original plans were to house 100,000 people and a factory to produce the *VW*. Although interrupted by the War, modified plans went ahead and the population has almost reached that target. The town is laid out in neighbourhood units separated by belts of forest. The economy of the town is based almost completely on the *VW*. Accommodation is mostly in flats and each of the neighbourhoods has its own shopping centre, school and church.



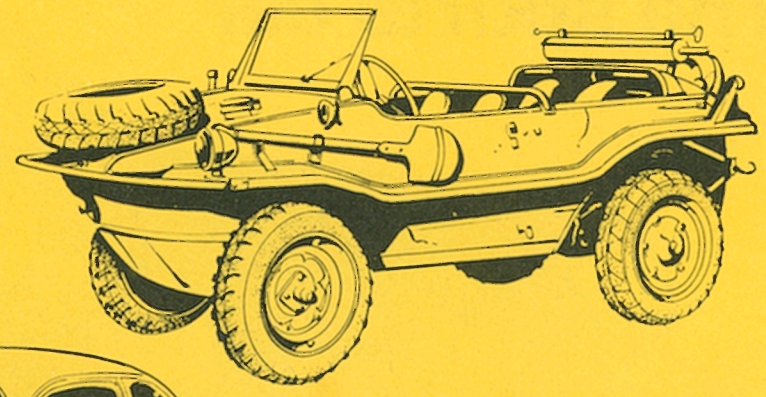


*The 1937 Volkswagen prototype*

The first production models of the *Beetle* forerunner—the *Kdf-Wagen* were completed in 1939. With only 210 *Kdf-Wagens* finished Hitler ordered the new factory to switch to military vehicle production (above right). Production started up again with the encouragement of British Army officers in 1945.



*The 1945 VW identical to the 1938 Kdf-Wagen.*



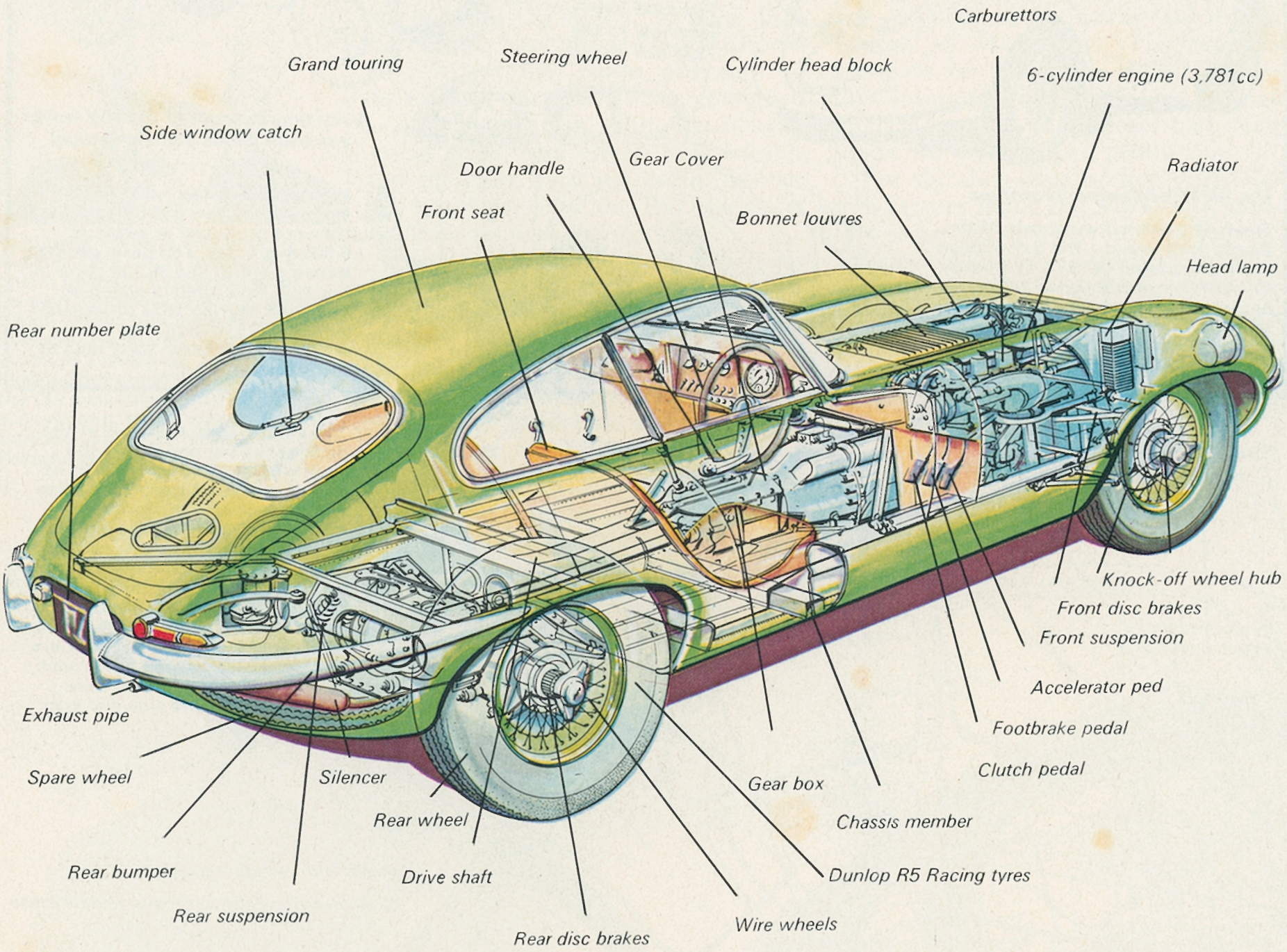
*A wartime product of the VW works —the amphibious Schwimmkübel*

In that year nearly 1,800 *Volkswagens* were produced. Now they are produced at a rate of 5,000 every day. The basic design remains but of the 35,150 parts all but two have been changed or modified. During 1972 production exceeded 15 million, the previously unbeaten total held by the *Model 'T' Ford.*

The *Volkswagen* engine is at the back of the car and drives the back wheels. This means that no power is wasted taking the drive along the length of the vehicle by a propeller shaft. The engine is cooled by air, this means that there is no water to boil in hot weather or to freeze in the winter. The engine does not take up very much space at the back of the car. It has four cylinders, but they are not pointing upwards as in most engines. They are laid on their sides—two on one side and two on the other.

*Driver's rear view mirror*
*Pivotwindow panels*
*Internal catch*
*Gear lever*
*Battery isolated from engine compartment*
*Rear luggage compartment*
*Engine louvres*
*Air filter*
*Dynamo with voltage regulator*
*Combined stop lights, tail lights, and reflectors*
*Fan belt*
*Petrol pump*
*Exhaust system*
*Distributor*
*Coil*
*Swinging halfaxle*
*Longitudinal torsion bar*
*Hydraulic double acting long stroke telescopic shock absorbers*
*4-speed synchromesh gearbox*

# The sports car




**A famous name amongst sports cars is Britain's Jaguar. They are very fast, good to look at and reliable. The price is much lower than that of most other sports cars. For these reasons they are very popular and many are exported. This is the *'E' type Jaguar.* The first ones were made in 1961, and had a top speed of 151mph. In 1966 a new type the *2+2* was made to carry four people. The maximum speed has dropped to 137mph and the headlamp fairings have been removed. In 1971 a new version was introduced powered by a V-12 engine. Above is pictured the 1966 model.**

## From speedster to GT coupé

Very few sports cars were made before 1914, but they became very popular in the 1920s. In America sports cars were called speedsters. European sports cars in the 1920s were either light two-seaters like the French *Amilcar* and the *Salmson* or larger four-seaters. Amongst these, the *Bentley*, *Sunbeam* and *Vauxhall* were very popular. The American speedsters used parts from ordinary cars built into special bodies.

In Europe in the 1930s cars like the *Wolseley Hornet* and the *M.G. Midget* were made, which were based on ordinary mass produced cars. A lot of these were sold but though they were fun to drive they were not the best of sports cars. The hand made cars like the *Alfa-Romeo*, *Aston-Martin*, *Frazer Nash*, *Bugatti* and *Clement-Talbot* were much better. They were also more expensive and not many of them were made.

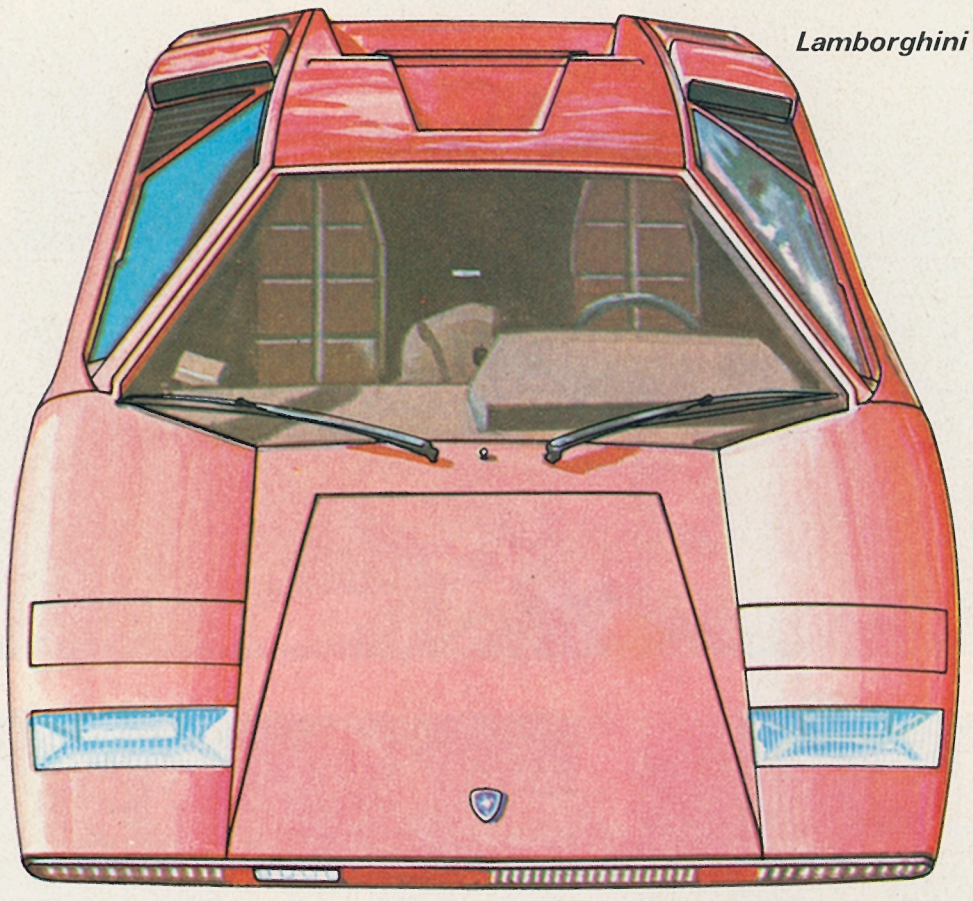
By about 1955 sports cars became more streamlined. They were often developed from ordinary production models which were made to go fast. This was done by working on the engines to give them more speed and more power. They call this 'tuning'. *Renaults*, *Fiats* and *Fords* were all used by racing drivers, and the experience gained by racing cars made from standard saloons made it possible for the engineers to make better cars.

Open two-seaters were popular until about 1960, but now people want more comfort and they prefer the GT coupé type of sports car. Britain is the only country still making many open two-seater sports cars such as the *Sprite*, *Triumph TR6*, *Morgan* and *Jaguar*.

*Porsche Carrera*

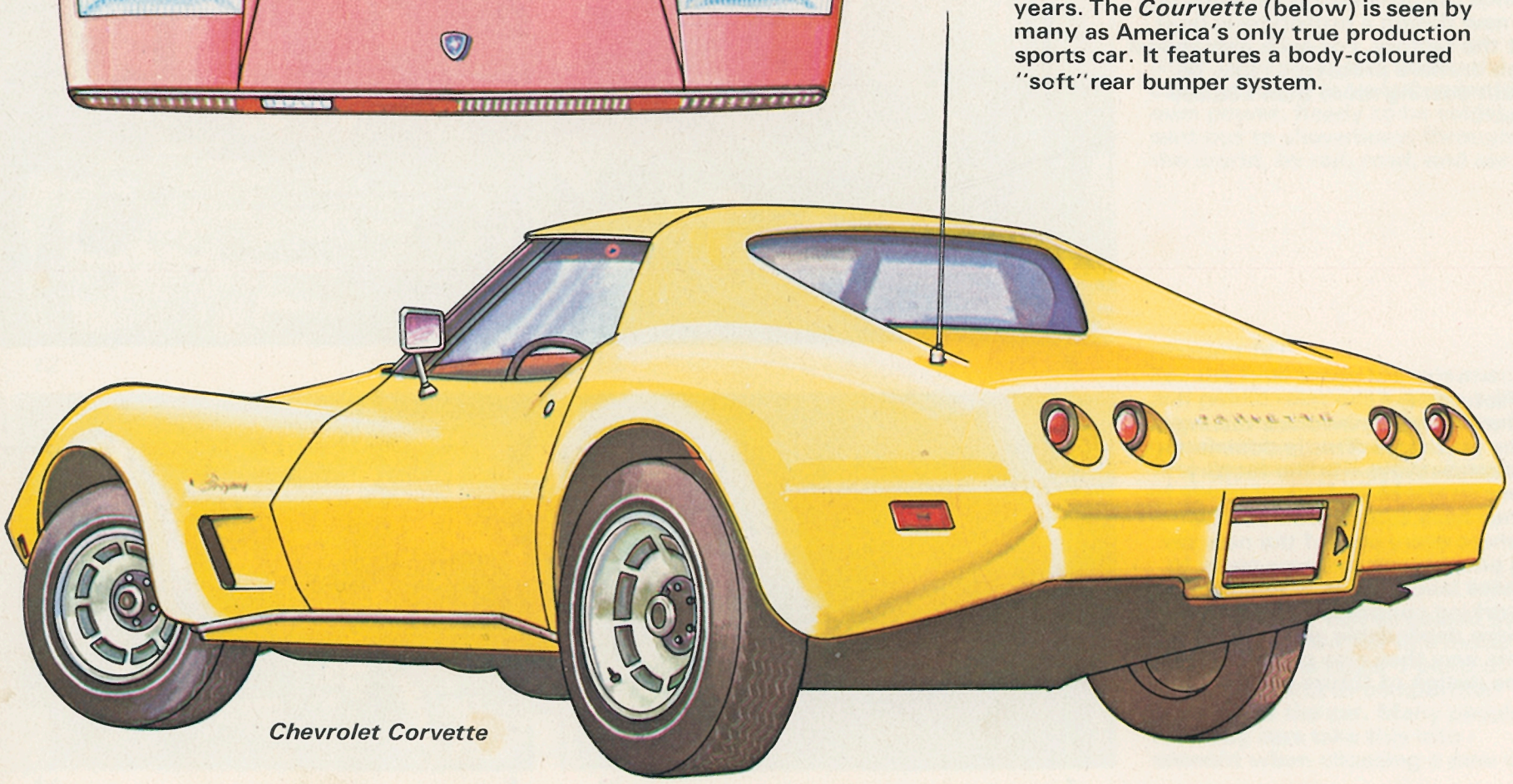
There are few makes of sports car that have emerged from Germany. Of those that have, there is one that has been very successful. Porsche sports cars have been dominating GT racing and rallying for the last few years. The *Porsche Carrera* (left) has a 6 cylinder 2.7 litre engine and a claimed maximum speed of 150 mph. It is the most powerful model in the Porsche range and like the *Jaguar 'E' type* has an extra two rather cramped seats.

*Lamborghini Countach*



Italian sports cars and racing cars have been very successful in competitions over the last ten years. There is the *Ferrari* the *Maserati* and the *Alfa Romeo* with *Fiats* and *Lancias* based on production cars. It is unusual that some of their best and fastest cars have not been raced, although they have very good performance. One of these is the *Lamborghini*. Ferruccio Lamborghini makes tractors, but as he was interested in sports cars he decided to make some in 1963. A recent model that he has made is the *Countach,* which costs over £10,000, but can do 190+ mph.

Many of the sports cars in the U.S.A. are imported from Europe, but Chevrolet have been making sports cars for over twenty years. The *Courvette* (below) is seen by many as America's only true production sports car. It features a body-coloured "soft" rear bumper system.



*Chevrolet Corvette*

# Launching a new car

## Drawingboard to showroom

Seeing a new car in a showroom it is easy to be unaware how much work and money is required to put it there. A new model is the result of months, and possibly years, of work for hundreds of people. Well before the first new model even comes off the production line millions of pounds will have been spent on making tools and changing the factory around. Parts of the factory may well have to be rebuilt and more machines may be needed.

The whole process starts when designers and stylists produce plans for a new car. Apart from a good design the new car must be easy to mass produce. Other people have the job of finding out exactly what sort of car people will want to buy. This is called market research.

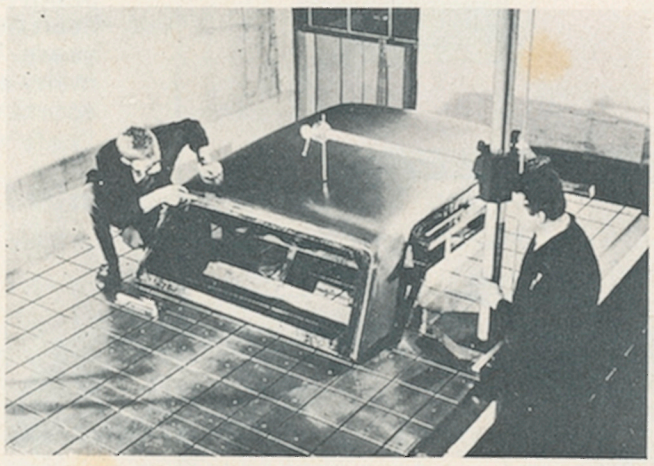
Next a prototype of the new car is built and the design is tested. If the design is found to be good the factory will be prepared for production.

When a new car is put on the market, the manufacturers spend a lot of money on advertising. They also exhibit the car at motor shows.

*(Picture 1)*
**A new car is first conceived by designers and stylists. They have to produce improved designs as well as incorporating the latest technical developments. They also are influenced by market researchers who advise them what sort of car the public will want. Since millions of pounds are involved, the final decision on whether or not to produce a new car is a very difficult one. The decision must be made by the main board of the company.**

*1*

*(Pictures 2, 3)*
**Once the go-ahead is received on a new design a prototype is built at the factory. For each new model ten or more prototypes may be built costing more than £30,000 each.**



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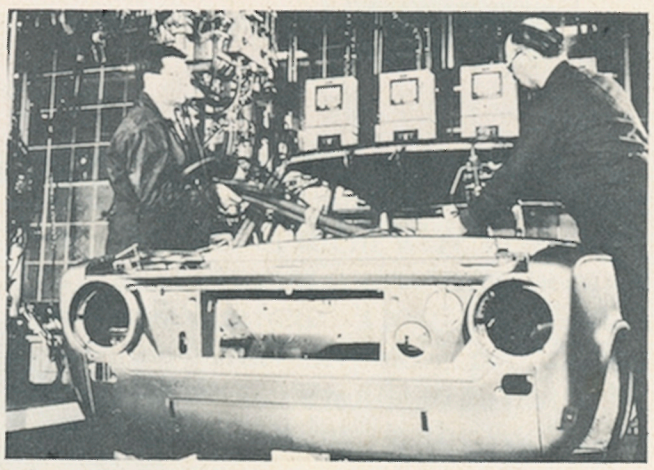
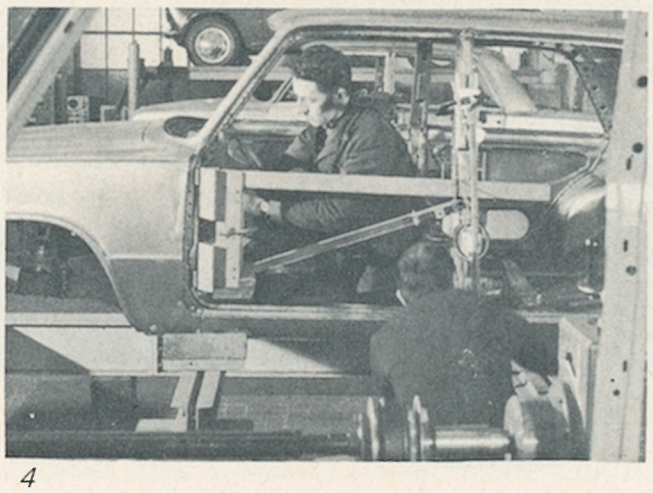


*3*

*(Pictures 4, 5)*
**The next stage involves testing the prototype. This is done in two separate ways—in the factory and on the road. In the factory they have special laboratories where every part of the new car is put through extreme tests. In these laboratories, specialists are working continually to make parts more dependable and safe. In this way they also contribute to the design of future cars.**



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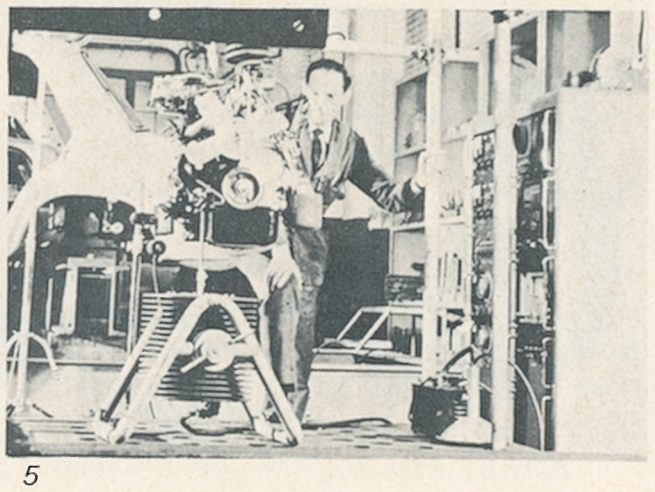
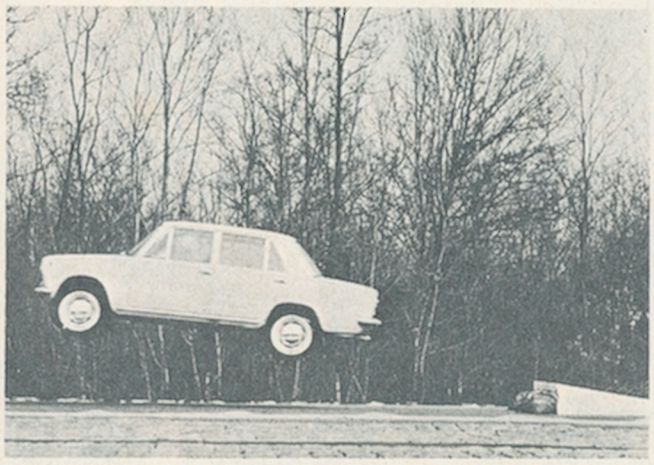


*5*

6

7

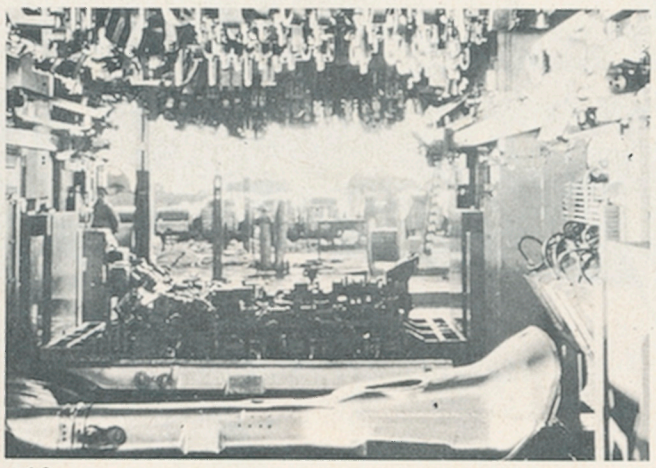
*(Pictures 6, 7, 8)*
The fully assembled prototype is then tested out on the road. The car is exposed to the conditions that might be found in the many parts of the world in which it will be sold. It is also a check on the results of the laboratory testing. It is at this stage that it is most difficult to keep the new car as a secret, while on road tests prototypes are often cleverly disguised. On the manufacturers own testing ground the car will be put through other tough tests. These include deliberately crashing into concrete barriers.



8

9

*(Pictures 9, 10)*
With the experimental stage successfully completed the process of making the new car begins. The factory is re-equipped, and its layout rearranged. Dies are cast and the components pressed.



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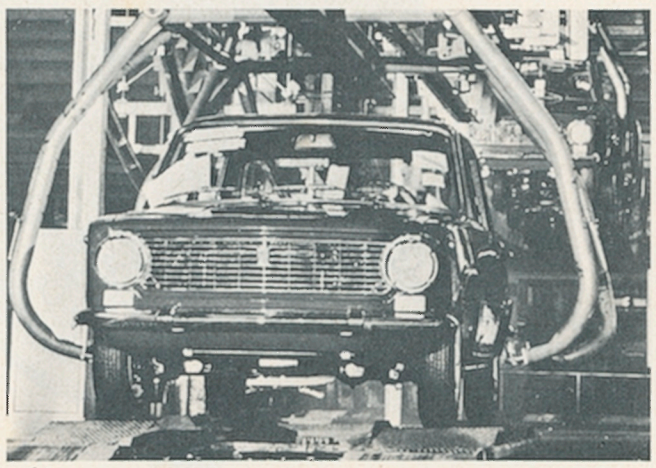


11

*(Picture 11)*
With the assembly line set up, cars in the making move along the belts. Various parts of the car are assembled separately. With precision timing the various parts are finally brought together and the car comes off the assembly line completed.

12

13

*(Pictures 12, 13)*
After inspection and timing the completed car is tested under its own power. Ready to be sold it is sent out to showrooms throughout the world, by rail, road, and sea.

14

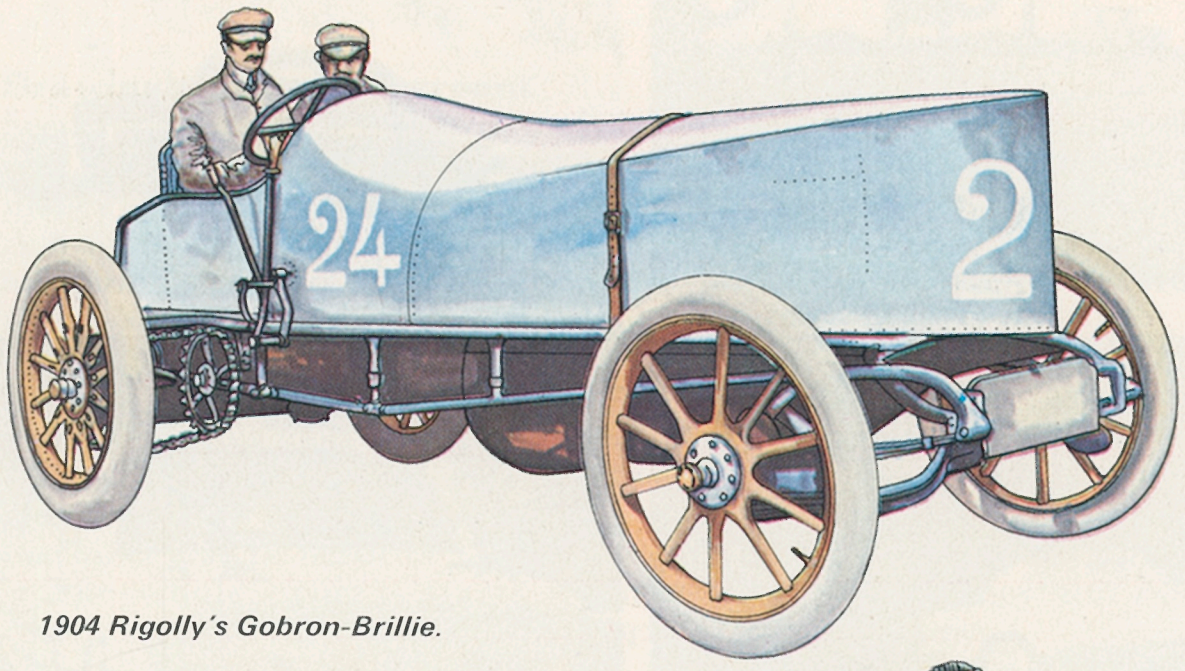
15

*(Picture 14)*
For the final stage the salesmen and public relations experts take over. Much money is usually spent on advertising a new car. Its first appearance is often at one of the International Motor Shows.

*(Picture 15)*
More publicity can be gained by entering the new car in a motor rally. From the buyer's point of view, this form of competition really tests the car. Many people who buy cars take this into account when choosing a new car.

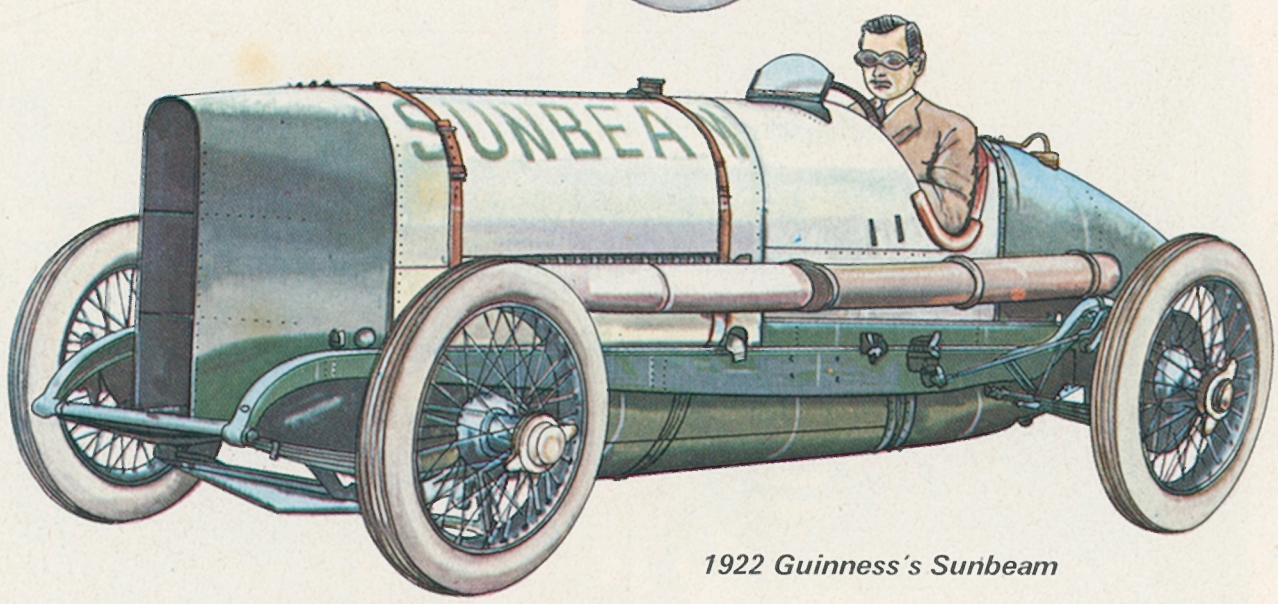
# Record breaking

There always have been men who like to drive their cars fast. In 1904 at a normal race meeting at Ostend in Belgium, for the first time a man travelled at faster than 100mph. Louis Emile Rigolly drove a 100hp *Gobron-Brillie* (right) at 103·56mph over a timed kilometre.



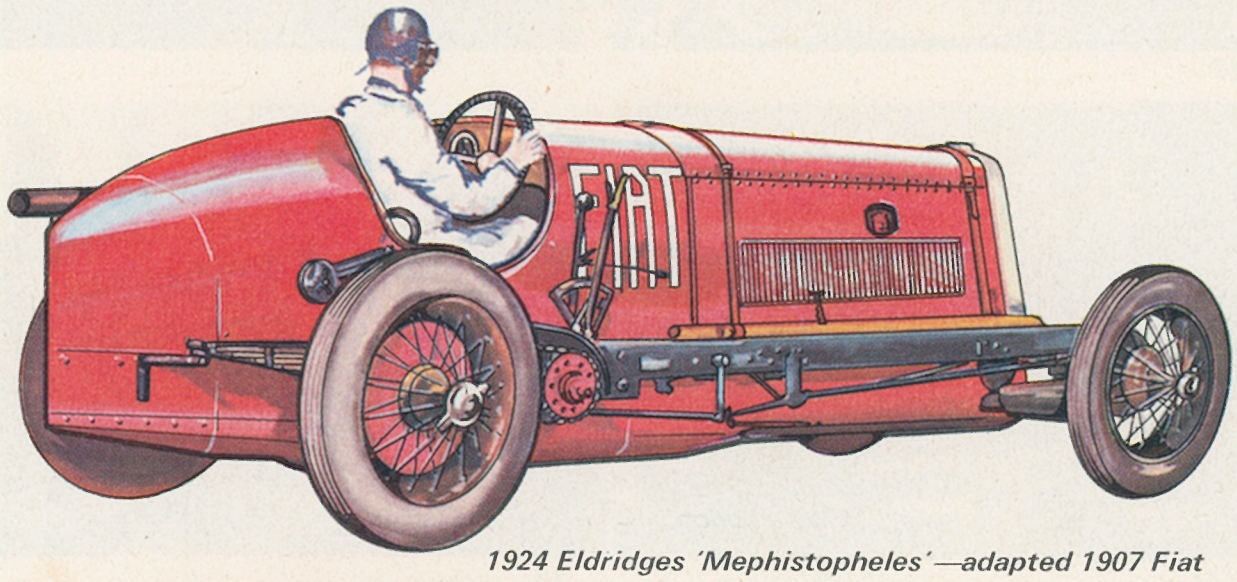

*1904 Rigolly's Gobron-Brillie.*

In 1922, Kenelm Lee Guinness pushed the world record to 133·57mph in his 350hp 12 cylinder, aero-engined, *Sunbeam* (right). This was the last time the record was broken at Brooklands.



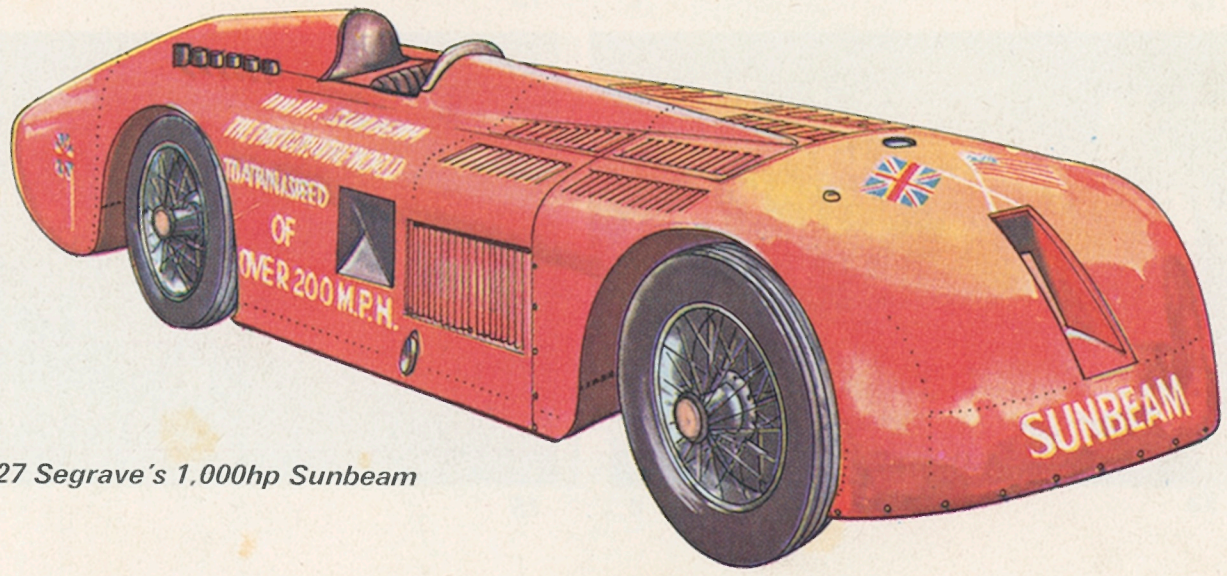

*1922 Guinness's Sunbeam*

The last record to be made on a road was by Ernest Eldridge in his 1924 car, *Mephistopheles* (right). The 'Mad Englishman', as he was known, drove his reconstructed 1908 *Fiat* with its new engine at 146mph.

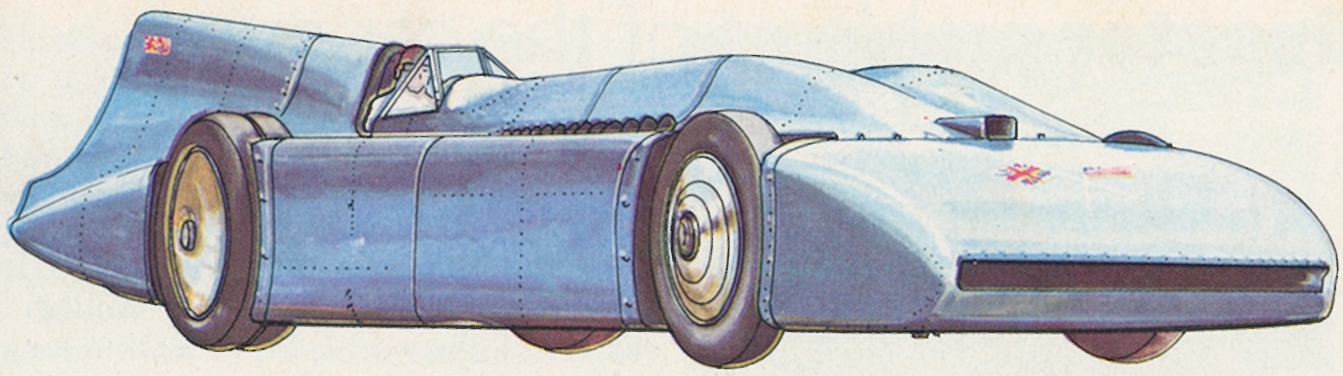



*1924 Eldridges 'Mephistopheles'—adapted 1907 Fiat*

From 1927 to 1935 all the records were broken at Daytona Beach in the US. The 200mph barrier was broken when Sir Henry Segrave drove his 1000hp *Sunbeam* (right) at 203·79mph in 1927.

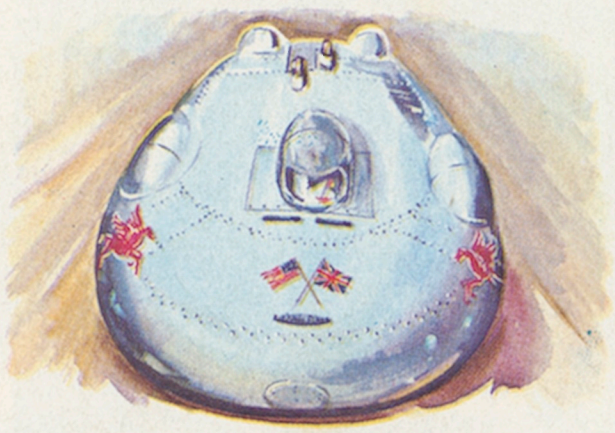



*1927 Segrave's 1,000hp Sunbeam*



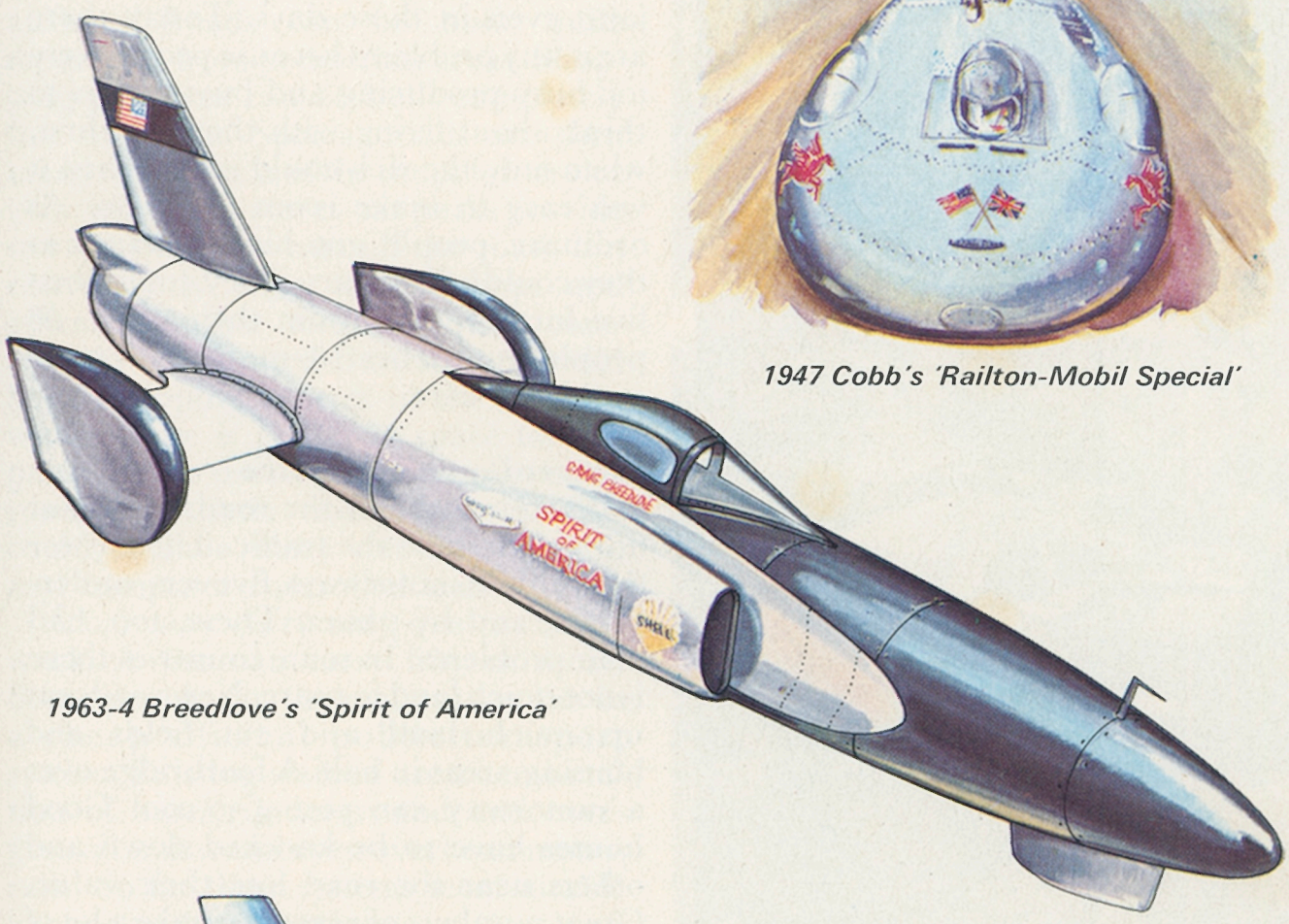
*1935 Sir Malcolm Campbell's 'Bluebird'*

Nine years later the record was pushed over 300mph by Sir Malcolm Campbell in the special Rolls-Royce Campbell car, nicknamed the *Bluebird* (right). The new record was 301·13mph and the run was made at Bonneville Salt Flats, Utah, in the US. *Bluebird*'s engine was the forerunner of the Merlin aero engine to be used in the famous World War II warplane, the *Spitfire.*



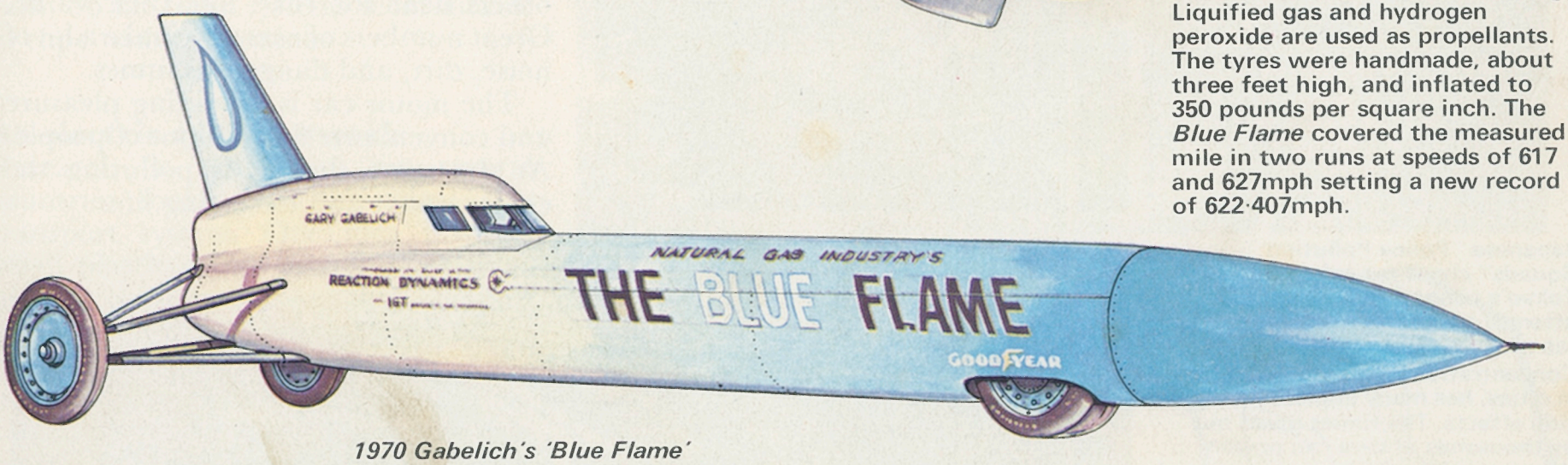
*1947 Cobb's 'Railton-Mobil Special'*

It was not until after the War that a car was driven faster than 400mph. On the south-north run at Utah, John Cobb drove his *Railton-Mobil Special* (left) to 403·135mph. The official record, calculated from this and the north-south run was 394·20mph.




*1963-4 Breedlove's 'Spirit of America'*

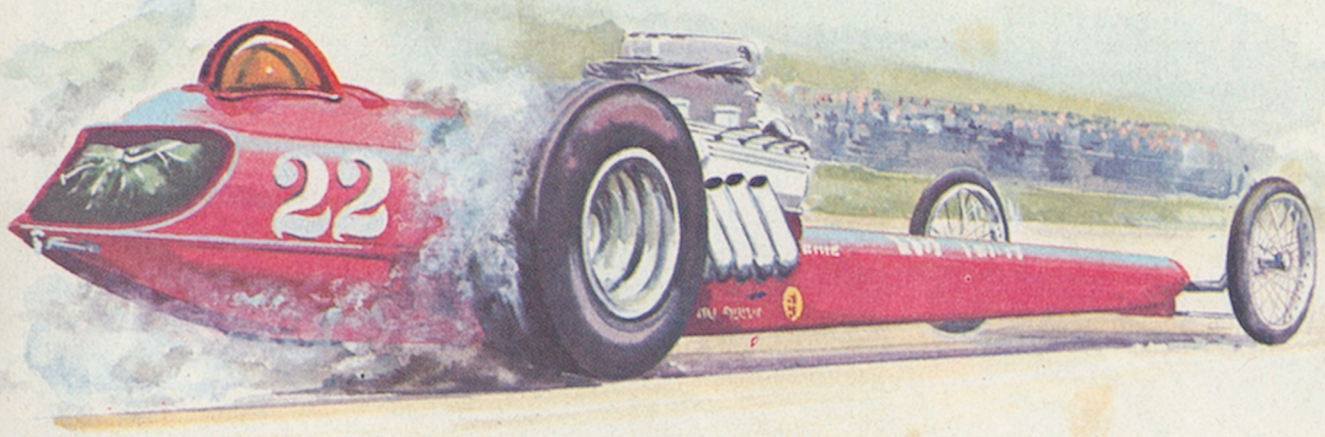
Again at Utah, in 1963 and 1964 the record was pushed beyond 400mph and then 500mph by Craig Breedlove in his jet powered *Spirit of America* (left). Controversy surrounded these records and others made by competitor, Art Arfons, in his jet car, *Green Monster.* Existing rules excluded vehicles not driven through the wheels. Breedlove's 526·28mph record of October 15, 1964 was finally recognized. Later Breedlove abandoned this car in favour of a four-wheeler *Spirit of America—Sonic I.* The best performance achieved in the second car was 613·995mph on November 15, 1965.




*1970 Gabelich's 'Blue Flame'*

The record was broken in October 1970 on the Salt Flats by Gary Gabelich. He was driving a specially built 'car' called the *Blue Flame* (below left). It was built and sponsored by the United States Institute of Gas Technology. Liquified gas and hydrogen peroxide are used as propellants. The tyres were handmade, about three feet high, and inflated to 350 pounds per square inch. The *Blue Flame* covered the measured mile in two runs at speeds of 617 and 627mph setting a new record of 622·407mph.

## Drag Racing




Drag racing is a form of sprinting in a straight line. Two cars, known as dragsters take part in each race. The cars have huge rear wheels and powerful engines. The fastest have tuned up V8 engines. They can cover the quarter mile in under 7 seconds. At the start they spin their wheels and disappear in clouds of smoke. By the time the quarter mile is completed they are travelling at over 200mph and parachutes are needed to stop them.

# **Blessing or disaster** problems of the car era

The real problems of the motoring age are not caused by the car itself, but by the great numbers of them there are on the roads. The more cars there are, the more roads are required. The better the roads become the more people find the car convenient. So the numbers of cars and the cost of finding room for them seems to spiral upwards endlessly. In many cities where millions of people travel to work by car the situation is constantly on the brink of chaos. Huge time-wasting traffic jams are an everyday occurrence (right).

Japanese "Police Pollution Squads" check car exhausts in Tokyo's congested streets in an attempt to control air pollution (above).

Concentration of traffic, especially in cities, has many unpleasant side effects. The fumes given out by thousands of cars can poison the atmosphere and even cause a special type of fog known as smog. Apart from gases, car exhaust contains solid matter.

### From horses to traffic jams

There are more than 217 million vehicles in the world. Most of them are in North America and Europe. In some countries the road system has not changed very much since the days of horses. In big cities there were traffic jams even in those days. Today there are many problems because people were too busy producing and buying cars to think about living with them. At first, when only the rich could afford cars, it was easy to make room for them. As ordinary people got higher wages so they could afford cars. They could then live further away from their work. As people got richer so more and more could buy cars.

### Convenience at a price

With so many cars the roads were just not able to take the traffic. The answer was to build motorways, flyovers, under-passes, and by-passes. These, too, had their problems. In some countries there is not much land to spare. New roads eat up much land and cut fields and housing areas in half. A footbridge over a motorway can cost £30,000. Good houses have to be knocked down and others near the road lose their value. Great numbers of cars also make a lot of noise, dirt, and dangerous fumes.

The motor car is providing pleasure and convenience for millions of people. At the same time it is polluting the environment and menacing life.

Traffic can flow freely, but at great expense. This view (right) of Detroit's freeway system shows how greedy for land the solution can be. Note, how the road cuts the town in two.

## Public versus Private transport

In some capital cities, like Rome and New York, they have thought about banning cars altogether. Few people will accept this solution. They think they should be free to own a car if they want to.

Heavy taxes on cars and petrol is another way of reducing the number of cars. So are road tolls and parking meters. The trouble is that these are unfair on poorer people.

Better city planning is another answer. Roads can be built quite separately from pedestrian areas. Shopping precincts can be built completely free of traffic. Special roads are then taken to the backs of the shops for service vehicles. Multi-storey car parks provide storage space for cars off the road, but conveniently close to the shops and offices. Another solution, quite common in the United States, is to build huge shopping centres in the suburbs where there is plenty of space for car parks. Better use can be made of existing roads by stricter traffic control. This could include more one-way systems and computer-controlled traffic lights.

A car may carry only one person to work. A bus can carry fifty or more. Some people say the real answer lies in a cheap efficient public transport system. Existing systems are a combination of buses, underground and overground trains and even overhead monorails. So far these systems seem unable to cope with congestion.

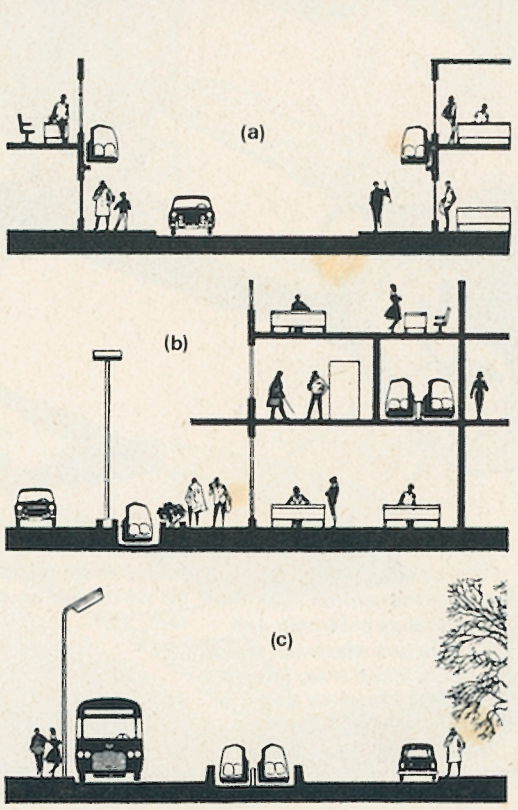
One method of rationing the space in crowded city centres has been parking meters (left).
If parking is expensive many motorists will be put off using their cars. Instead they will use public transport. In the future cars may be fitted with meters. These could measure the distance travelled and the time spent in crowded areas. Motorists could then pay for the amount they use the roads.

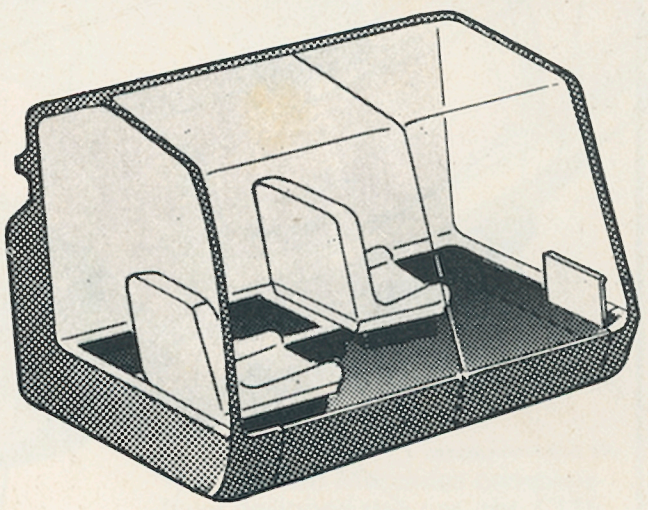
In the US., suburban shopping centres are built to serve cities where there are too many cars in the central area (below). In these centres people can buy most things they need. This saves making journeys to the city centre.

## An electric cabin network

Research is going on in several countries looking for an ideal city transport system. One idea involves small plastic cabins electrically driven over a computer controlled complex system of track. The track would be cheap and light so that it could go practically anywhere. Passengers would choose their destination on a map and receive a card. This card would then be fed into a slot beside the seat and the cabin would go automatically to the destination. This system has many advantages. They include relative cheapness, freedom from noise and pollution, higher average speed, and ability to handle heavy traffic. If this system, or ones similar to it, will probably provide a practical solution to congestion in the cities.

People must decide for themselves which is the more important. Freedom for everybody to travel the way they want or an efficient transport system.



Tomorrow's answer to congestion, pollution, and noise in the cities could be this simple cabin (above). Cabin tracks are light and can run almost anywhere (left). Some possibilities shown are: (a) along the sides of buildings, (b) along the sides of roads and through buildings, (c) along the central reservation of a road.

# **The death toll** and the safety revolution

| *Fatal Road Accidents* | | | |
|---|---|---|---|
| Country | | | |
| W. Germany | | | |
| | 1 in every | 3,220 | persons |
| France | ,, | 3,460 | ,, |
| USA | ,, | 3,721 | ,, |
| Italy | ,, | 5,292 | ,, |
| Japan | ,, | 5,903 | ,, |
| UK | ,, | 7,404 | ,, |

The table above brings out the big differences in the chances of being killed in a car accident in each of the big car countries. (Figures for 1972 except France 1969)

## Menace on the roads

Each year 130,000 people are killed and possibly 1,700,000 are seriously injured. These startling figures refer not to a war but to road accidents in the western world. What is more, the numbers are rising rapidly.

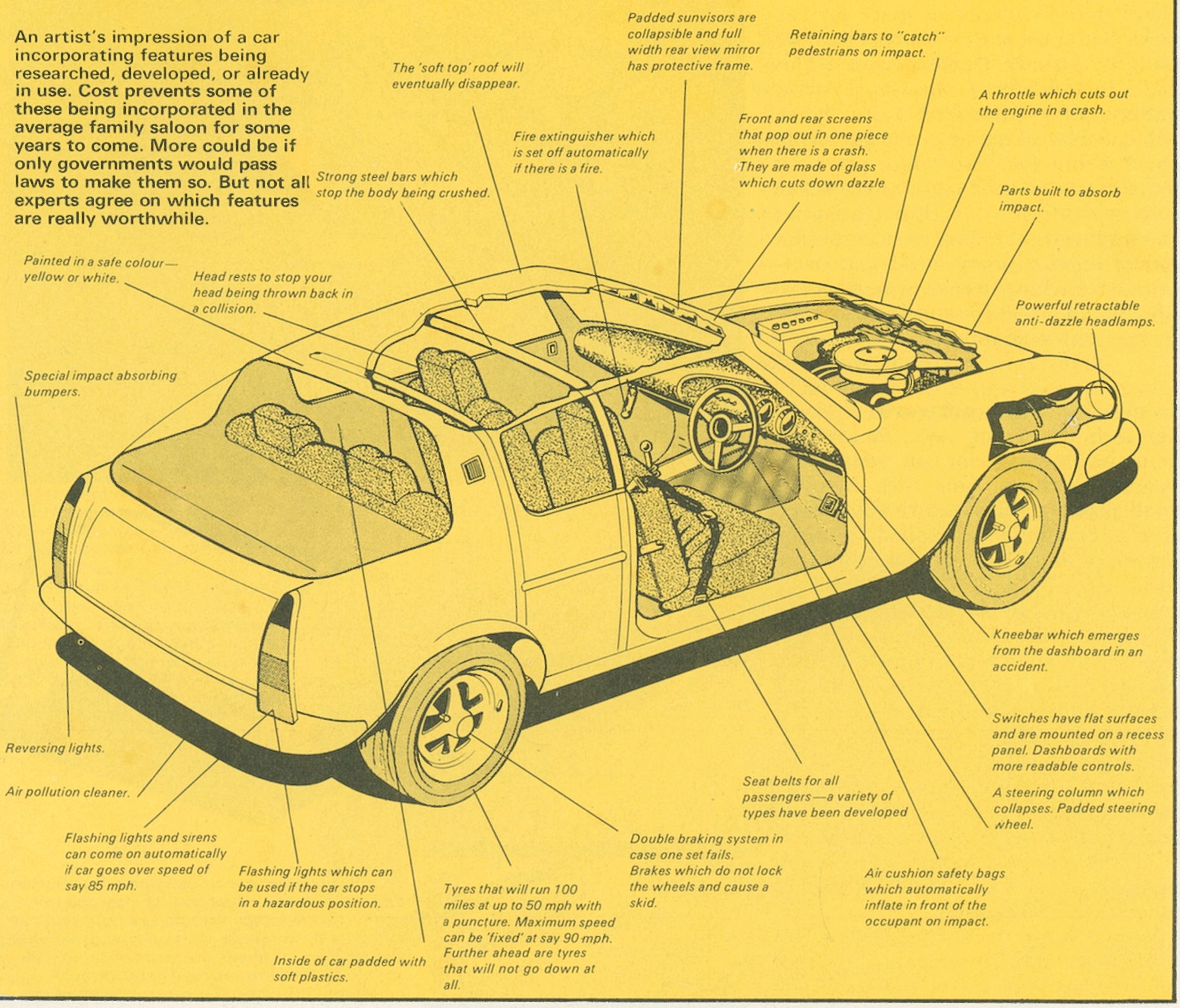
For years cars have been made with little regard for the fact that they can kill and maim. Now that road accident figures have reached such proportions, people are at last beginning to realise that something must be done. Laws are being passed to ensure that cars are made safer, but progress is slow. Too many people still think it is more important that cars look good and go fast.

## Life in their hands

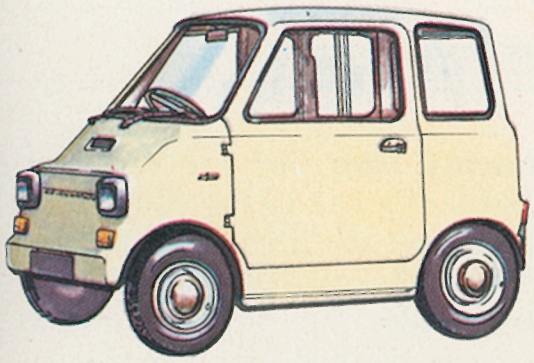
Safety on the roads depends more on the driver than on the car itself. Many drivers do not have the necessary skill and rely on other road users for their safety. Others may suffer from physical disabilities such as poor eyesight. The reactions of many drivers are too slow, perhaps due to the effect of alcohol, or even old age. The solution to these problems depends not only on the car manufacturers, but on everybody who uses the roads.

## The 'As safe as possible car'.

An artist's impression of a car incorporating features being researched, developed, or already in use. Cost prevents some of these being incorporated in the average family saloon for some years to come. More could be if only governments would pass laws to make them so. But not all experts agree on which features are really worthwhile.


Padded sunvisors are collapsible and full width rear view mirror has protective frame.
Retaining bars to "catch" pedestrians on impact.
The 'soft top' roof will eventually disappear.
A throttle which cuts out the engine in a crash.
Fire extinguisher which is set off automatically if there is a fire.
Front and rear screens that pop out in one piece when there is a crash. They are made of glass which cuts down dazzle
Strong steel bars which stop the body being crushed.
Parts built to absorb impact.
Painted in a safe colour—yellow or white.
Head rests to stop your head being thrown back in a collision.
Powerful retractable anti-dazzle headlamps.
Special impact absorbing bumpers.
Kneebar which emerges from the dashboard in an accident.
Switches have flat surfaces and are mounted on a recess panel. Dashboards with more readable controls.
Reversing lights.
A steering column which collapses. Padded steering wheel.
Air pollution cleaner.
Seat belts for all passengers—a variety of types have been developed
Flashing lights and sirens can come on automatically if car goes over speed of say 85 mph.
Double braking system in case one set fails. Brakes which do not lock the wheels and cause a skid.
Flashing lights which can be used if the car stops in a hazardous position.
Air cushion safety bags which automatically inflate in front of the occupant on impact.
Tyres that will run 100 miles at up to 50 mph with a puncture. Maximum speed can be 'fixed' at say 90 mph. Further ahead are tyres that will not go down at all.
Inside of car padded with soft plastics.

# Experimental cars for the future



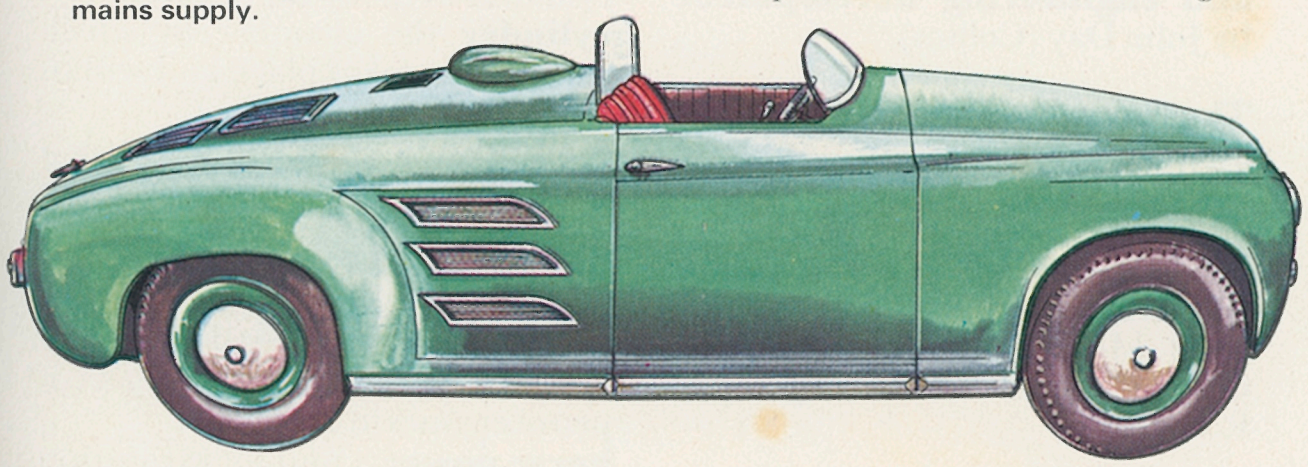
*Ford's experimental electric car*
**Several manufacturers have been experimenting with electric traction. The main problem has been the weight and size of the battery. Recent research has brought the possibility of a lighter and smaller battery which can be recharged at night by the house mains supply.**

It is not easy to predict what is going to happen to car design in fifty years' time. Before then, all cars may well be fitted with automatic transmissions. Cars will be built to give the best possible safety and economy, and engines will not cause any pollution of the air. Design will be improved until there is almost no need for servicing after every 3 or 5,000 miles. Many components will be sealed after manufacture and will have fairly long lives. Some will be made of plastic.

When a certain number of miles have been travelled by the car, a light will come up on the dashboard telling the driver to change a part.

Much work has already been done producing practical alternatives to the petrol powered engine. Foremost in research have been gas turbines based on the jet engine used in aircraft, and electricity, already in use in milk floats. Atomic power, solar batteries, and even steam is being considered.

Many factors determine which of the many new inventions will be adopted for mass production. The important ones are that they should be economical on fuel, quiet, reasonably exhaust free, and light in weight. Above all they must be safe and cheap to mass produce.

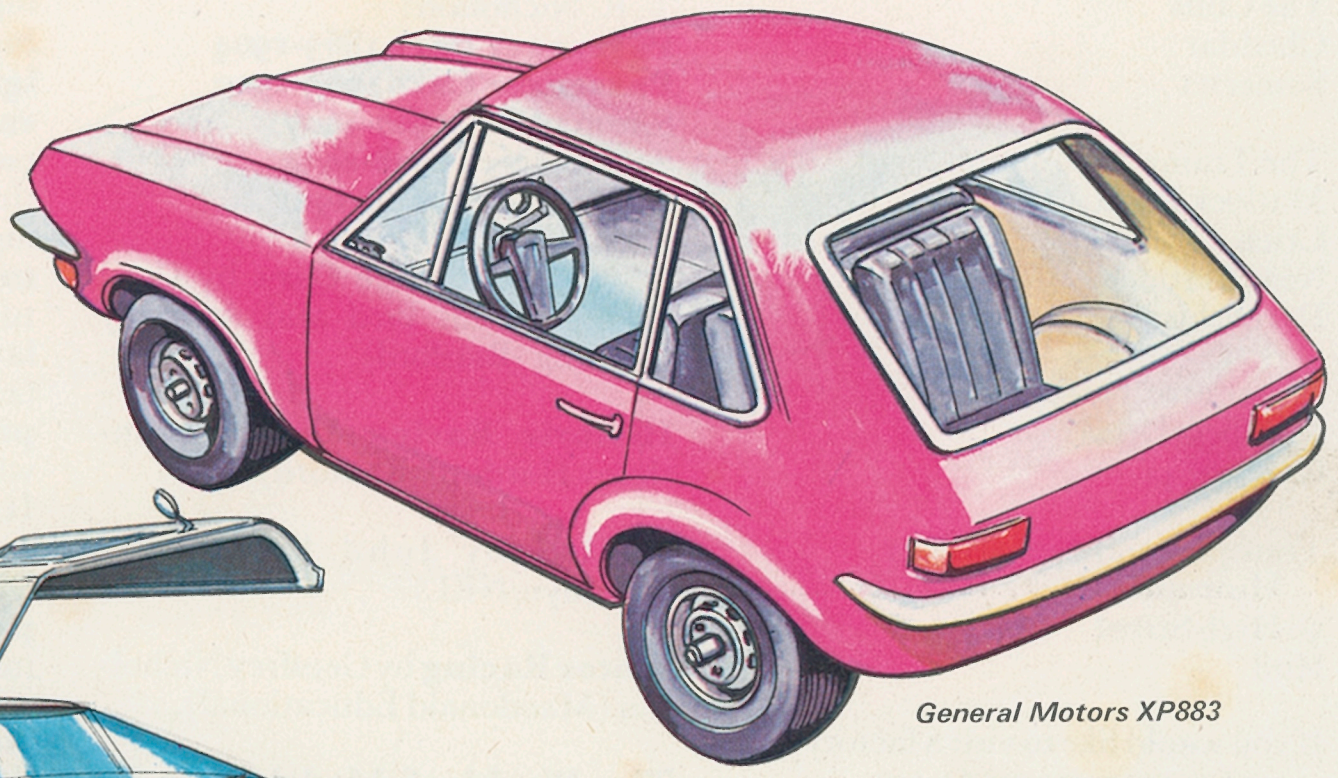


*Rover gas turbine car*

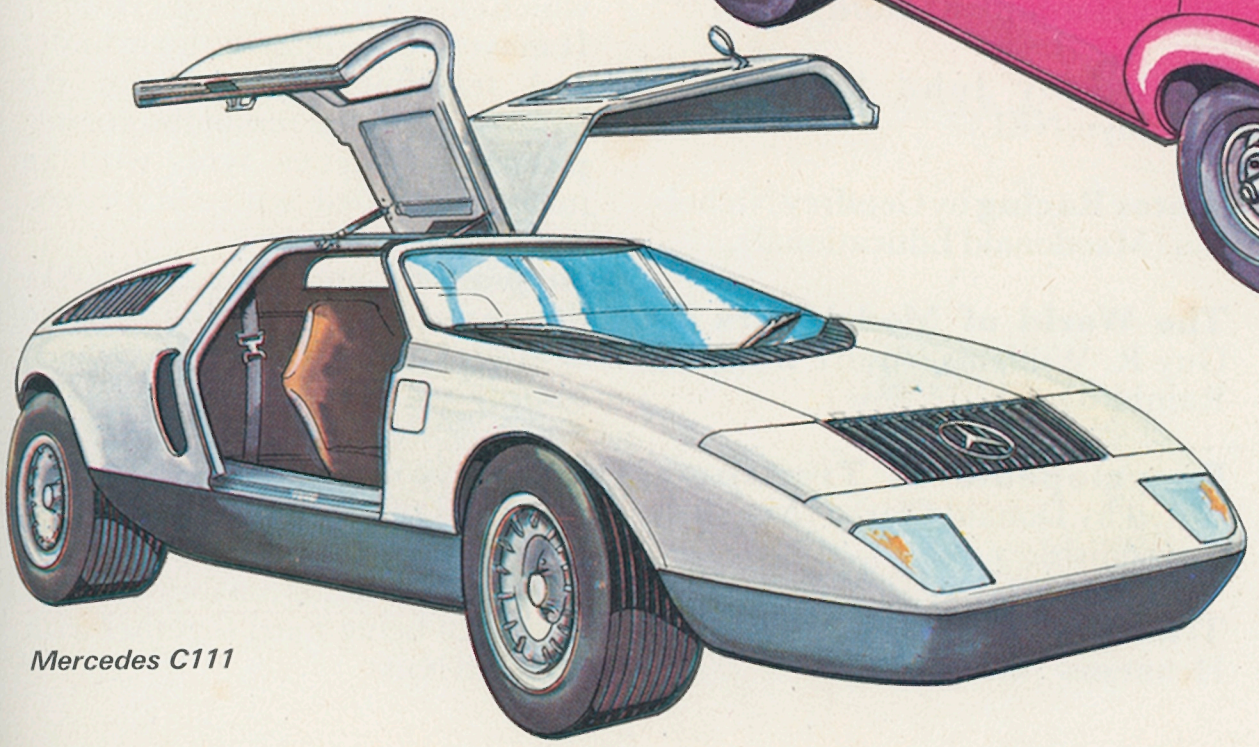
**The main problem with gas turbines has been to produce a light enough engine that is also inexpensive.**

**This is the world's first gas-turbine motor car. It was designed and built by the British Rover Company. It could travel at nearly 152mph and went from 0 to 100mph in 13·2 seconds.**

**This is an American idea from General Motors for a city car. It is called the XP883. The body is made from fibre glass which will not rot. There are two motors. An electric motor driven by batteries at the back is used for moving off. When the car is moving the petrol motor at the front takes over. If extra speed is needed, both motors can work together.**



*General Motors XP883*



*Mercedes C111*

**The German Mercedes company have designed this car, the *C111,* for research and development of the possibilities of the new Wankel rotary engine. They are studying, in particular, the relationship between the low weight engine, the body, and road holding. It has a glass fibre body and five speed gearbox. This is the second version and accelerates from 0-60mph in under 5 seconds. Top speed 187mph.**

# Things to do

## Places to visit

This is a selection of the museums which have exhibitions of cars; there are of course many others. It is always worth visiting a small local museum to see if they have an exhibition of cars.

National Motor Museum
Palace House
Beaulieu
Hampshire
This is the largest and most famous of motor museums, with both vintage and modern cars.

Transport Museum
Witham Street
Newtownards Road
Belfast

Museum of Science and Industry
Newhall Street
Birmingham 3

Cheddar Motor and Transport Museum
The Cliffs
Cheddar
Somerset

The Tramway Museum
Matlock Road
Crich
Near Matlock
Derbyshire

Museum of Transport
25 Albert Drive
Glasgow 41

Transport and Archaeology Museum
36 High Street
Hull

If you would like to visit a factory to see how cars are made, try writing to:

Bernard Smith
4/311A Ford Motor Company (G Building)
Dagenham
Essex
for a visit to a Ford factory, or

B. J. Sperring
Public Relations
Rover Company Ltd
Solihull
West Midlands
for a visit to any BLMC factory.

## Books to read

**The Complete Catalogue of British Cars** by David Culshaw and Peter Horrobin (Macmillan).

**The Motor Car: Its evolution and engineering development** by John Day (Collins).

**The Guinness Book of Car Facts and Feats** edited by Anthony Harding (Guinness Superlatives).

**Early Days on the Road: An illustrated history 1819-1941** by Lord Montague of Beaulieu and G. N. Georgano (Michael Joseph/Rainbird).

Blandford *Cars of the World* series by T. R. Nicholson:
**Passenger Cars 1863-1904**
**Passenger Cars 1905-1912**
**Sports Cars 1907-1927**
**Sports Cars 1928-1939**
**Racing Cars 1898-1921**

**Guide to Vintage Cars** by Cecil Clutton, Paul Bird and Anthony Harding (Batsford).

**Historic Racing Cars** by Anthony Harding (Batsford).

**Rally!** by John Davenport (Hamlyn/NEL).

**Motor Racing** by Geoffrey Nicholson (Macdonald Educational).

**The World of Model Cars** by Guy R. Williams (André Deutsch/Rainbird).

**Encyclopedia of Transport** edited by Donald Clarke (Marshall Cavendish).

**Transport** by R.A.S. Hennessey (Batsford).

## Glossary

**assembly line** the line carrying the parts of a car to be assembled. People along the line add different parts until the car is complete.
**carburettor** the part in which petrol is vaporized and mixed with air, thus forming the fuel for combustion in the cylinders.
**cubic capacity** (cc) is measured in cubic centimetres or litres (1000 cubic centimetres = 1 litre). The volume measured is the space in the cylinders swept by the pistons.
**cylinder** the chamber in which combustion takes place and within which the piston moves.
**disc brakes** brakes which push a pad on to a disc at the centre of the wheel.
**four-stroke engine** an engine in which the piston has a cycle of four strokes or movements within the cylinder. This system is the basis of petrol engines in use today.
**horse power** a unit for measuring the power of an engine by comparing it to the power of a horse drawing a load.
**ignition** the method of starting an engine by which an electric spark passes from a battery and a coil through a distributor to the sparking plugs.
**mass production** the manufacturing of cars or any other goods in large numbers by machinery in a factory.
**piston** a circular disc of metal which closely fits inside the cylinder. It moves up and down the cylinder and transmits energy from the ignited fuel to the rest of the engine.
**pneumatic tyres** tyres with an inner tube filled with compressed air.
**suspension** an essential to make the car comfortable and able to hold the road well. It is a spring coil compressed between two plates on the body placed near each wheel.
**unit body chassis construction** a method of construction in which the body and chassis are welded together to make a metal box instead of being fixed together with nuts and bolts.

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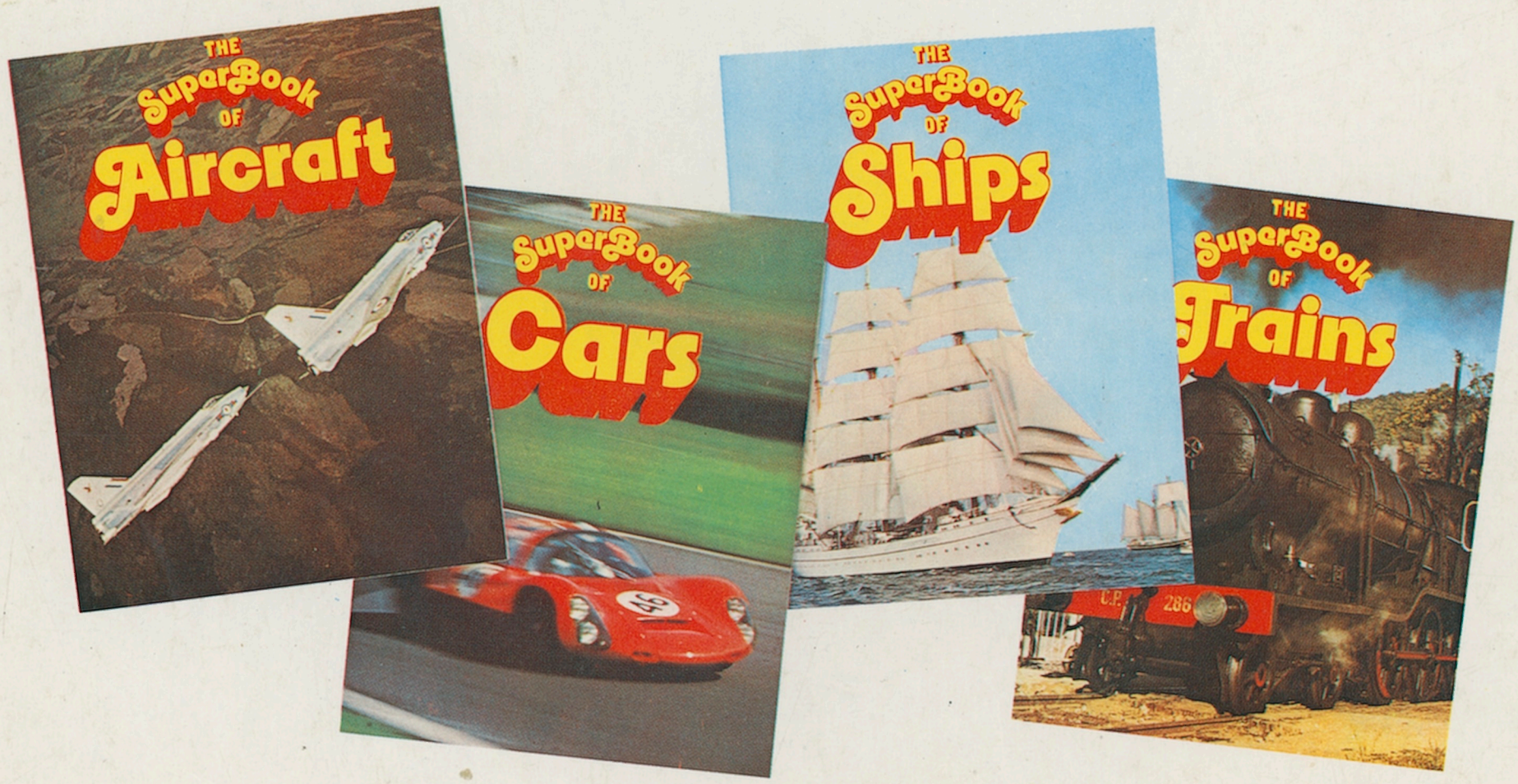


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